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*Washington, March 20, 1907.*

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,  
*Acting Secretary.*

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## PREFACE

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The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April, 1907, as means of supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes, and comments on topics of medical interest, and reviews or notices of the latest published medical books.

The bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of commendation to authors of papers of outstanding merit and will recommend that copies of such letters be made a part of the official records of the officers concerned.

The bureau does not necessarily undertake to indorse all views or opinions which may be expressed in the pages of this publication.

C. E. RIGGS,  
*Surgeon General United States Navy.*

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The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

Contributions must be received two months prior to the date of the issue for which they are intended.

The editor is not responsible for the safe return of manuscripts and pictures. All materials supplied for illustrations, if not original, should be accompanied by a reference to the source and a statement as to whether or not reproduction has been authorized.

The **BULLETIN** intends to print *only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc.* All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect.

VIII



# U. S. NAVAL MEDICAL BULLETIN

VOL. XXVIII

JANUARY, 1930

No. 1

## SPECIAL ARTICLES

### **THE FRONTAL ATTACK ON YAWS—A PLEA FOR A CHANGE IN STRATEGY<sup>1</sup>**

By P. W. WILSON, Lieutenant Commander, Medical Corps, United States Navy

The success of a public health service in any country is dependent on, first, the amount of money at its disposal; second, the number and character of its personnel; and third, the degree of education of the mass of the people. The degree of educational enlightenment determines to a large extent the degree of success to be expected. Given a population that is not only illiterate but superstitious and fatalistic, the public health program has to be modified to meet conditions. The organization, administration, and strategy of any public health service is analagous to that of an army at war. Discipline, devotion to duty, and esprit de corps are just as essential in the one as in the other, and good strategy is just as necessary. Political support without political interference is of paramount importance. There is but one essential difference between the two—in the war waged by the Public Health Service there is never any armistice, not even a truce of a few hours.

In presenting the problem which confronts us to-day please consider that I am not finding fault with any of the past or present plans of action that have been undertaken. Quite the contrary. Considering the money and limited personnel available we have every reason to be proud of the accomplishments of the Service d'Hygiène from the time of its organization to the present, but I believe the time is now ripe to deliver the coup de grâce to the yaws pandemic. My reasons for urging especial and extraordinary attention to yaws at this time are as follows: First. The time is propitious because of the work already done which has prepared the way for the "wiping up." Second. The successful elimination of yaws from Haiti would greatly increase the confidence of the people and facilitate later educational work. Third. Yaws is still a cause of great economic loss, and it is believed that while no small progress has

<sup>1</sup> Read before the third annual congress of the Haitian Medical Society, Port au Prince, Haiti, April 24, 1929.

been made, yet we will have it always with us unless it is eradicated from the more isolated districts and thus prevent contamination of districts that have already been cleaned. Fourth. Ninety per cent of the population live in the country districts and are open to infection. Fifth. The yaws pandemic is the only public health problem which can be solved within a relatively short time.

In regard to the last point you will pardon me if I elaborate, for it is probably the only point concerning which there may be a difference of opinion. Certainly we all agree that we can not hope to completely eradicate tuberculosis, epidemic meningitis, hookworm, malaria, dysentery, or typhoid fever from Haiti within the lifetime of anyone here present or for many years longer. The principal reason why this can not be done is the ignorance of the people. If it were necessary to rely on education in carrying out a yaws extermination program we could not hope for an early and successful termination. But the writer is convinced that at the present time there are but few if any adult Haitians who do not know there is a safe and quick relief from yaws. All authorities agree that intensive and widespread mass treatment is by far the most efficient and economical method of combating and eventually eradicating this disease. To quote from the last edition of Stitt's *Diagnostics and Treatment of Tropical Diseases*: "Yaws is essentially an epidemic disease and the question of treatment should be looked upon perhaps more as a public health measure than as a matter strictly in the field of therapeutics, since treatment must be directed more at the mass than at the individual, and results obtained may be measured more in terms of the decrease of incidence than in the healing of certain lesions." Patterson in his paper on Bismuth Salts in Yaws, read before the Tropical Medicine Congress in Jamaica in 1924 said:

In any of the organic arsenical preparations we have a drug the exhibition of which on one or two occasions results as a rule in the complete disappearance of the secondary granulomatous eruption of yaws within a few days, and almost certainly renders the patient either noninfective or at least very much less infective for a considerable period, even when a complete cure is not effected. Also, as the relief which is afforded is not only remarkable, but practically immediate, there is not, at least among the African natives of Kenya, any difficulty in securing the attendance of those sick who are able to walk and are within a reasonable distance of a hospital or dispensary. It would therefore appear that, in order to secure the eradication of the disease from any district, all that is necessary is so to multiply the facilities for treatment, and so to increase the accessibility of these facilities, as to insure that all cases existing in the district shall receive treatment so far as possible simultaneously; also to make provision for the treatment of all others who may be incubating the disease, as soon as recognizable signs present themselves, and for the treatment of any cases which may happen to relapse at a later date.

With a dispensary open one day a week in every rural section in Haiti (there are about 552) under the direction of a doctor or experienced dresser it is very probable that yaws would soon disappear. This is, of course, impossible, considering the funds and personnel available. The work that has been done thus far is noteworthy, and interesting questions arise from the following statistics. These figures are taken from the annual reports of the director general Service d'Hygiène for the fiscal year ending September 30:

Total injections given for treponematosi: 22,905 in 1922; 27,396 in 1923; 50,647 in 1924; 105,827 in 1925; 229,481 in 1926; 378,749 in 1927; and 550,945 in 1928. The increase in the number of treatments given is easily explained—increased funds expended for specific drugs; the introduction of bismuth because of its low cost; and increased personnel to give the treatment. But the question arises, is this enormous expenditure of effort and money going to increase each year, and for how many years? Another question, How many of the cases who received the 551,000 injections in 1928 had their mother yaw since September, 1924, when the bismuth treatment was instituted? Of course it is impossible to even hazard a satisfactory reply to either question. But a third question naturally presents itself and that is: Is there not a better way to handle the yaws pandemic with the idea in view of its early eradication than the method now in operation?

In proposing for consideration any change in the plan of campaign against yaws it is necessary to study the defects in the present plan of operations, and adopt a different strategy that will prove more effective. The principal reason why yaws is confined to the rural districts is because of the automatic and popular quarantine exercised by the city dweller against the disease. Early infectious cases of yaws are not and never have been allowed to remain in town, and until recently any case arising in town was compelled by his neighbors to take to the hills. This was brought very forcibly to my attention when the campaign against yaws was first begun in the district of Jacmel and before the establishment of rural clinics. Townspeople told me that as long as they could remember no case of early yaws was ever allowed to remain in town overnight if they were discovered on the streets during the day. When cases finally began to come in to the Jacmel hospital many of them told me that they had been accosted on the street and told in no uncertain manner to get out of town before sunset. The hospital in Jacmel is located at the extreme western limit of the city, and for a long time the yaws patients coming to the hospital from the country east of the city made a complete detour around the town and left by the same trail in order to avoid embarrassment at the hands of the city

people. The central location of the general hospital in Port au Prince probably explains to a large extent why we have seen so few cases of early yaws in that clinic. When yaws reaches the ulcerative stage it is not recognized as yaws by the city folk and these cases may pass anywhere unmolested. There is no doubt but that the immediate neighborhood of every rural dispensary is practically free from infectious yaws.

Yaws is the one disease of shame in Haiti, and a large proportion of the early cases will not go more than an hours walk, or out of their immediate neighborhood, to receive treatment. How often have we all seen adults come into the clinic with handkerchiefs draped over the head to hide the lesions on the face that are not covered by the clothing! How often do we see a mother bring in an oblong bundle completely wrapped in a cloth which on being unwound reveals almost invariably a child with infectious yaws! Gentlemen, the solution of the yaws problem is clear if we expect to rid ourselves of this pest within the next 50 years. We must treat these cases where they are, and in a given district as many of them as possible simultaneously. Instead of building more dispensaries for the present, we need mobile dispensaries, i. e., tents for the work and living quarters for the personnel. The doctors and dressers attached to these units should be volunteers if possible, and the dressers should be paid a salary that will not only compensate them for the work they do but also for the hardships they must undergo. Of course the ideal campaign would mean that we would have two or three such units working in each sanitary district at the same time. Whether such an intensive campaign is possible or not depends entirely on the funds and personnel available. Lacking these, however, there is no reason to be discouraged. Happily the Hatian countryman is not migratory. He is firmly attached to his land and house and seldom moves. From three to five units could work intensively in one region at a time until all the infectious cases have been treated, then move to the adjacent neighborhood and so on until the entire country has been covered. Certainly there will be sporadic cases arising after the units have passed on, but in these areas quarantine measures could be taken just as in smallpox until the case together with his contacts receive treatment.

I will not take your time in discussing further the details of such a campaign, but it is believed that in the treatment of yaws in the infectious stage the bismuth treatment should be abandoned, sulpharsphenamine or stovarsal given in its stead, and a second treatment of stovarsal delivered to the patient, which he would be instructed to take a week later. I do not need to point out that such mobile dispensaries would be of immense benefit in many ways other than the eradication of yaws. In closing I would like to hear dur-

ing the discussion of this paper an expression from the younger unmarried men of the profession and the internes who will soon graduate, as it is upon the shoulders of some of these men that the brunt of the burden would fall. I wish to add that in all my years of civil and Navy practice I personally have never experienced as much satisfaction in results as I did over the work done in attempting to eradicate yaws from the arrondissement of Jacmel.

**EDITOR'S NOTE.**—Immediately following the close of the Congress, the supply officer of the public health service of Haiti conferred with Doctor Wilson as to the necessary equipment, personnel, pack animals, etc., for a new unit known as the traveling clinic. On May 1, 1929, the unit left to undertake an intensive campaign against yaws along the Morne La Selle Range and valleys. On the second day out, after successfully negotiating a descent of the notorious "Glass Mountain," they established camp south of Furcy at an altitude of 3,000 feet. This trip immediately brought to light several omissions and mistakes in their equipment, the most important of which is the uselessness of the side pack. The mountain trails are in many places too narrow to permit the passage of side packs. Native carriers must be used instead.

By May 19 the camp had progressed to Marche Lamarque (at an altitude of 5,000 feet). Because of the nature of the terrain, the American doctors in the unit have given it the name of "crawling clinic." News of the clinic spread rapidly and patients were soon coming even from the south coast, the trip necessitating a crossing of the Morne La Selle Range via almost impassible trails. Patients unable to walk were being carried. Some were making the trip three times a week.

To the yaws patients who can not come to the camp, stovarsal tablets are supplied via relatives and friends—a benefit not possible with the former methods of treatment. Although the unit is concentrating on yaws, it treats all comers—intestinal parasites, malarial infections, carious teeth, etc. After all is said and done, the real Haiti is in the country, and the traveling clinic supplies a long-needed link in the present chain of 142 rural dispensaries. So excellent are the results to date that plans are now being effected to organize and equip two more units to function along the lines outlined in Doctor Wilson's paper.

The public health service of Haiti has been aided in this work by the aviation unit, U. S. M. C., which sends planes twice a week to drop food and mail and to exchange signal messages.

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### PSYCHOLOGY IN AVIATION

By D. G. SUTTON, Captain, Medical Corps, United States Navy

Procurement of officer and enlisted personnel for aviation pilot training in the Navy is becoming an increasingly difficult problem. While a sufficient number of officers and men have reported for training, the number of individuals actually completing the course has not been large enough to supply the demand. Unfortunately, the demand is increasing while the supply of acceptable material seems to be relatively decreasing. A recent survey of the aviation personnel situation at the naval air station, Pensacola, was made by

Korb (1). This survey covered the period of one year from June, 1927, to June, 1928. It indicated among other things that the percentage of candidates completing the course was as follows:

Officers with previous training.....	39
Officers with no previous training.....	60
Enlisted men, aviation ratings.....	40
Enlisted men, other ratings.....	17

These figures seem to indicate that the means of selecting the aviation material is at fault, or that the method of training is in need of revision. In the end it may be found that both factors are concerned. It is apparent that this problem is an international one, and every country is making a definite effort to solve it.

Medical authorities are scrutinizing the physical requirements for aviation with a view to accentuate what they consider to be the essential elements, and to eliminate those requirements having no appreciable value. Others are experimenting with an apparatus such as the Ruggles orientator or the Reid aptitude apparatus with the hope that some relatively simple means of selecting aviation personnel will be developed. Still others are of the opinion that the answer to the problem lies within the psychological field. Dock-eray (2) believes that while temperamental individuals may become good flyers, they can not be relied upon. He believes that one of the most important factors to estimate is the degree of emotional stability. Longacre (3) is of the opinion that every flyer should be sufficiently stable to withstand any type of stress that he may be called upon to bear, and Ickstadt (4), after a study of 486 students at Pensacola, concluded that within qualifying limits no correlation existed between physical findings and ability to fly. He further concluded that aeronautical adaptability must be determined through neuropsychiatric examinations. These opinions and others seemed to indicate the necessity for a thorough investigation into the situation and instructions were issued by the Navy Department for the inauguration of a psychological survey on this station.

In the accomplishment of this study, every individual presenting himself for aviation training was given a detailed psychological examination. The examination includes a detailed family history as well as a personal history. The latter is obtained with the view of ascertaining the individual's reaction to his environment from childhood, his means of handling serious problems, and his normal reactions to adversity as well as to success. Following this we attempt a study of the personality on a plan outlined by Amsden (5). The investigation is conducted by detailed questioning under essential psychological captions, having in mind the special problem at hand. In addition, we attempt to evaluate the reaction time by conducting the Domino test, which up to date has served its purpose very well.

Other tests of the same type have not been so satisfactory because of the length of time it takes to conduct them. Finally, an opinion as to the individual's emotional status is expressed. With the information available following the various tests and the detailed psychological examination, each candidate is given a rating on a basis of four. This final mark is arrived at by averaging his marks in intelligence, responsibility, reaction time, judgment, stability, memory, and attention. In addition, the examiner notes on the form the individual's outstanding character traits.

With these findings before us, it may be possible, after a sufficient number of students have completed the course, to study the situation and point to those factors having a bearing on success and failure. If such a thing can be done, then it should be possible to standardize the psychological examination so that the frankly unfit may be eliminated on primary examination rather than later at Pensacola, when much time and money have already been expended. Up to this time the psychological estimate of the situation has been correct to an impressive degree for those students who have terminated the course, but no definite opinion of the method can be arrived at until several hundred have been acted upon. Then if it is found that the psychological estimates check fairly well with the individual's degree of success we may be able to form an opinion as to the governing factors. At present we are merely accumulating data for subsequent analysis and study.

A survey of this type presents many difficulties that appear superficially to be insurmountable. In the first place, there has been relatively little done in the matter of personality study in the normal individual. Studies of the various psychotic groups have been made and instructive deductions drawn by prominent men in the profession, but very little material can be found in the literature concerning the normal man. We are all more or less familiar with certain well-recognized types of personality, but we have no definite means of estimating character components in one or all of these types in their true value. Self-consciousness in one individual may appear to be a disqualifying factor, while in another the same degree of self-consciousness may have no bearing because of other traits that neutralize it. It is necessary in our present problem to properly evaluate emotional trends, aggressiveness, courage, initiative, confidence, and many other personal traits having a bearing on the individual's availability for aviation.

In our routine contacts we see experienced pilots who very probably would be considered poor aviation material because of introverted or extroverted tendencies, had they not proven themselves capable by the acid test—that of actual flying. However, flying a

combat plane in peace time with all of the attendant risks can not be compared to the same procedure in time of war. In the latter situation the element of personal danger is very much increased, so that we would expect the frankly unstable individuals to react adversely. After a time the examiner senses the successful type and in a large number of cases is able to estimate the situation.

In conjunction with the work now being done, it has been interesting to note a projection of the examiner's reaction to the candidate in the psychological findings in the case. This has not been seen frequently, but it has occurred often enough to be put in the class of errors to be avoided. On one occasion the examiner was so impressed by the good traits in the candidate that he failed to properly evaluate unfavorable characteristics which had been noted on the form during the examination. In another incident, when the candidate reacted adversely to both the examiner and the examination, the examiner noted only the adverse psychological factors when a review of the detailed form revealed many good components. All of which merely emphasizes the difficulty of the situation. One must not be led afield by one's personal feelings or leanings in work of this type.

In addition to the absence of a psychological standard on which to build, we are constantly confronted with a lack of standardization in other directions. This with particular reference to aviation instruction itself and service requirements in general. Where instructors and check pilots differ as to the way in which certain maneuvers should be performed, an impossible situation is created in so far as the student is concerned. It may be difficult to standardize instruction in a procedure where personality is such an important element, but if it could be done a very much larger percentage of graduates would leave Pensacola each year. That fact is very evident. The outstanding student may not be affected by variances between instructor and check pilot, but the average student will be, and, unfortunately, the border-line class harbors the greatest number of potential failures. It is assumed that efforts looking toward the conservation of available personnel will eventually be directed to this and other important elements of training.

Incompatibility between student and instructor or student and check pilot is of definite importance in the end result.

Within the past few months that part of the course of instruction involving combat flying has been made optional rather than mandatory. This should tend to increase the percentage of successful students since it eliminates that phase of flying involving the greatest element of danger. Combat flying demands well developed and rapid coordination, unquestionable courage, and excellent judgment



based on experience. In view of these outstanding qualifications, it is not difficult to appreciate why a large number of students formerly failed in the course before combat training was completed. It is reasonable to assume that those students will now graduate and be saved to the service. At a later date, after these students have gained experience at sea under service conditions, many of them should be available for instruction in advanced flying. It is anticipated that the change in instruction will eventuate in securing a larger number of combat pilots than under the original plan. On the other hand, it is realized that the elimination of relatively dangerous flying will allow a certain number of students to graduate who will never be of material assistance to the Navy as combat pilots under war conditions. These pilots should under normal conditions eliminate themselves. If they do not their defects will become so apparent that the aviation authorities will classify them and eventually restore them to the status in which they will be most useful.

Ordinarily a psychological estimate of a given individual is made with some knowledge of antecedents obtained through the medium of a relative or friend of the family. Such a procedure is not possible under the present circumstances, so that the candidate presents the family skeleton and all other pertinent information garbed in the covering that is calculated to make the best impression on the examiner. As a result much of the history obtained is either entirely false or molded to suit the circumstances. In those parts of the examination in which the candidate responds to direct questions, the examiner has a better chance of obtaining authentic information since it is possible to arrive at approximate truth by means of reaction time. Hesitancy or indecision on the part of the candidate very frequently indicates the correct reply to a question before the actual response is made. In outstanding cases the examiner can almost visualize the effort being made by the candidate to formulate a reply in keeping with what he thinks the examiner wants. In such instances the reaction time rather than the response is the valuable factor.

Up to this time the psychological examination has been reacted to in a normal way and a large percentage of candidates have been not only cooperative but interested. One student was antagonistic and uncooperative for no apparent reason, but he has been the only one among a large number that have been completed to date. Realizing that detailed investigation into the individual's sexual trends tended to develop antagonism to the examiner, a number of psychological examinations have now been completed in which direct reference to that subject has been practically eliminated. A discussion of such factors as indulgence, abstinence, and the usual forms of

abnormality is not forced upon the candidate, but very naturally the examiner is required to form some conclusion as to the individual's degree of progress through the three well recognized stages of sexual development. This is imperative. If a man has not progressed normally to the heterosexual level but has remained fixed at either the autoerotic or the homosexual levels, he probably will exhibit characteristics that are indicative. The same may be said of the individual who has regressed to the primary or secondary level after having at one time made normal progress. Evidence of regression should automatically disqualify since it is indicative of lack of control. An individual with such a reaction usually can not undertake a project involving the possibility of death or injury with any degree of success. Dependency upon others will not be recognized by the candidate and will of course be minimized by him, but diplomatic questioning will usually bring out the fact that he hesitates to formulate an opinion on important personal problems without advice from his parents or others to whom he is attached. Such a man is usually defective in judgment and initiative when he faces an emergency without the usual assistance. In the time allotted each candidate it would be impossible to discuss even the more superficial aspects of the sexual side of the problem in a constructive way. The average psychoanalyst finds that reference to the subject can not be safely made until after confidence has been established. Frequently relatively long periods of time pass before this is obtained. Lacking the necessary time, we are forced to depend upon reactions and surface indications to reach conclusions.

A cross section of the development of character or personality in an individual quite frequently indicates the struggles that have taken place. In most instances the ultimate traits have been developed as a result of compromise and adjustments along the road. Where the individual has not been capable of molding his environment to suit his demands he has had either to compromise or take a retrograde course. There are those that have to compromise in all of their contacts with reality. They very naturally have developed characteristics which are usually unmistakable. Such character traits as overcautiousness, indecision, hesitancy, and impaired judgment associated with complacency and a veneer of well-being are at once suggestive of the possibility that the individual has been retarded at a level that is indicative of abnormality. On the other hand, confidence, normal initiative, good judgment, and a reasonably aggressive attitude at once give the impression of normal progress in the past, so that the examiner is led to believe that the individual is capable of handling any situation within his intellectual range. In other words, the aviation student who has an average mind and who gives

no indication of an invalidating compensatory reaction should become a pilot if he has sufficient interest in success.

The one hour allowed for the psychological examination should be sufficient for our needs since we are dealing with a selected group, a group in which the matter of intellect should have very little bearing. No officer, or enlisted man having petty officer attainments, should fall below the intellectual level demanded in aviation. Our examinations to date point very strongly to that fact. However, we do deal with the emotions and such factors as responsibility, reaction time, judgment, stability, courage, memory, and attention. These and other essentials are much more difficult to determine than intelligence, and unfortunately there is no yardstick by which the emotions and other personality elements may be measured with any degree of assurance or success. The final opinion expressed relative to a given candidate is developed after a study of the findings and in terms of the examiner's experience. There can be no other means of handling the situation.

The psychologist should have a background of practical psychiatry in addition to a knowledge of laboratory methods. Medical officers having a superficial knowledge of psychology are a liability rather than an asset and for that reason, if the service is going to stress the mental element in aviation medicine, physicians of the proper type should be trained in sufficient numbers to handle the problem. Otherwise opinions expressed will carry very little force and confidence will not be maintained.

In addition to the work now being done to standardize the psychological selection of personnel, the medical officers engaged are accumulating data having a bearing on crashes in which the pilots have survived. After each crash the pilot of the plane is interviewed to obtain his explanation of the circumstances leading up to the episode and to determine the psychological factors having a bearing. In respect to the latter it has been interesting to note that original psychological information, obtained eight months prior to the crash in some cases, had some bearing on the accident under discussion. One such case was unusually interesting. The pilot in question had evidenced retarded mental reaction time, undeveloped powers of observation, and general indifference during his original psychological examination before his course of training had begun. On the day of the crash this pilot took off in an O2U to enter a formation of three planes at a given altitude. He failed to gain his position in two attempts and in the third came up under another plane in the formation which he did not see and washed out a part of the landing gear as well as one wheel of the plane above. As soon as contact was made he nosed his plane down and its tail was cut off

by the propeller of the plane above. As a result the pilot in question and his associate descended safely in parachutes and the occupants of the second plane were forced to make a one-wheel landing. No one was hurt. Did the undesirable psychological traits in the pilot responsible for the crash have a bearing on developments? The writer is of the opinion that they did.

In another incident the pilot was found on examination to be self-centered and sensitive, and the examiner expressed some reservations as to the individual's probable judgment in emergencies. The latter was based on indications of introversion that appeared to be evident. On the day of the episode the pilot was flying a land plane and had only a few hours before completing the full course of training. The plane went into a horizontal spin at a comfortable altitude, and as the pilot could not right it, he jumped and safely landed in a parachute. Observers on the ground who saw the incident reported that the plane came out of the spin itself after the pilot had jumped and before it headed down. Would a more stable individual than the pilot in question have been successful in righting the plane?

Our experience points to the fact that relatively unstable individuals exhibit poor judgment in emergencies involving the possibility of injury or death. The sensitive, self-centered type invariably has difficulty throughout the course of training, and those of the same make-up who have had many hours of previous experience prior to coming to Pensacola have difficulty with precision landings and small-field work late in the course. Previous experience has carried them through the primary work, but as soon as the more involved procedures are faced, the inherent characteristics take charge, and failure is the result. The writer has seen individuals of this type progress to within a few hours of the termination of the course and without ever having given evidence of inability to meet the requirements suddenly lose control of the situation and fail. A number of these students were given extra time and an opportunity to rest for a few days. Later they successfully continued training and were qualified. From the psychological standpoint it would appear that these men are bad risks. If an individual is going to buckle up in emergencies and after a normal period of flying under usual conditions, it would appear reasonable to assume that in time of war he would be of little use as a combat pilot. By the same token the student who has to call on every ounce of reserve that he possesses in order to carry on will find himself in difficulty when problems are presented in the air requiring unusual judgment. The normal reserve is lacking.

The matter of psychoanalytic approach to the problem of pilots having undesirable character traits has been considered generally

and with special reference to crashes. Up to this time no corrective measures have been attempted, since it is considered inadvisable to attempt psychoanalysis during the continuance of an individual's active course of training. To accentuate personality defects prior to or during the training would tend to make matters worse rather than better even though a means be suggested for correction.

The writer is of the opinion that recommendations based on the present study should not be made until at least 500 students have completed the course of training. If in the next six months radical changes are made in the method of pilot instruction or the system of checking is definitely changed, our work will become valueless. In that case a subsequent study should be made in light of the new standards.

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#### THE VALUE OF PERIPHERAL VISION IN DEPTH PERCEPTION, AS APPLIED TO AVIATION

By A. W. Loy, Lieutenant (Junior Grade), Medical Corps, United States Navy

In making proper contact with his environment, the aviator is absolutely dependent upon vision. Muscle sense may aid him in perceiving motion changes, but plays no part in determining his position in space. His semicircular canals are of practically no use to him. Cutaneous sensations are limited to those caused by wind blasts, and while they may indicate the direction of motion, the aviator does not depend upon them for any important information. The action of gravity, or centrifugal force, upon the body in sudden changes of direction, as in recovery from dives, causes localized changes in vasomotor tension; but information received from these sensations is of little value. If deprived of all sensations except vision, the aviator would be handicapped, but he would be able to adjust himself to the aerial environment.

Birds are flying animals from an early age. They form neural synapses for maintenance of equilibrium in the air. The large cerebellum develops in the training of the young bird in aerial equilibrium. The aviator is unfortunate in that he begins flying as an adult. He has no chance to form new synapses for adjusting himself to his new environment. He must depend upon vision for determination of position and upon definite, reasonable movements of his controls for making adjustments. He has no "aerial reflexes." To him flying is an intellectual adventure.

Often we note that the athletic fellow flies easily. We recall that he competes in games where he is constantly adapting himself to new situations. He dodges tacklers, secures the ball, and notes the positions of the players without looking directly at any one of them. The man making a double play in baseball develops a factor which is useful in flying. Without looking directly at either of the runners in a close play, he keeps his eye on the ball in receiving it. The runners are noted and distances judged through peripheral vision.

The aviator is of the intellectual type. Emotional impulses may bring about very undesirable results. His duty is a hazardous duty, and his safety depends more upon cool judgment than any other factor. The information of his relation to his environment, from which he forms his judgments, is received upon his retina.

The bird has the advantage of reflex equilibrium in flying, but it flies with monocular vision. Motion parallax, accommodation, and terrestrial association serves it for depth perception in alighting. Although the aviator must depend alone upon his eyes in flying, he has the advantage of binocular vision in landing. The aviator, with training, could use monocular vision, but binocular vision affords better depth perception. Unequal binocular vision is positively dangerous in making landings, but fortunately, in most cases of unequal vision, sensation in the poorer eye is ignored.

In a former paper<sup>1</sup> the value of specific nerve energy as applied to the two retinae in relation to each other, with the incidental crossed and uncrossed diplopia, was shown.

To the aviator, terrestrial association and motion parallax are of constant value. He keeps his central vision occupied with the position of his plane in relation to the horizon, or with the oil dial or airspeed dial. During the whole time, peripheral vision notes changes in position of wings, of clouds, horizon, and other planes in the vicinity. By motion parallax, peripheral vision notes the movement of a nearer point against the movement of the eye, while that of the more distant object is with the movement of the eye.

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<sup>1</sup> A study of the factors concerned in Depth Perception. *American Journal of Ophthalmology*, vol. 12, No. 2, February, 1929.

In landing, the aviator does not look at the field directly beneath him and then converge upon some part of his plane, enhancing a parallactic angle, in order to judge his distance from the field. He fixes his eyes upon a point on the surface of the field at some distance ahead of the plane, and by peripheral vision he notes the position of his plane in relation to the landing field. With fixation on the more distant point, there is crossed diplopia of all points on the landing area, and of all points of his plane. The diplopia of the points on the landing area is less widely separated than the diplopia of the points on the plane. The retinal areas stimulated by the points on the landing field are less widely separated than the retinal areas stimulated by the points on the plane. By the specific nerve energy, this information is conveyed to the fusion center, and the aviator forms his judgment as to the position of the plane in relation to the landing area. As the plane approaches the landing area, the retinal areas stimulated by the points on the landing area are shifted more widely apart, approaching the amount of separation of the retinal areas stimulated by the points on the plane. This information is conveyed by specific nerve energy, and the aviator adjusts his controls for the final lowering of the tail of the plane for the landing.

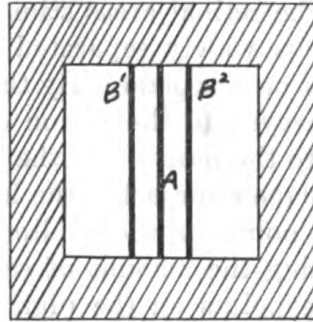
It is of interest to note that the aviator does not look directly at the landing area, nor directly at some point on the plane. He fixes his eyes on a more distant point of the field in making a landing. The judgments are formed from information received by peripheral vision. Specific nerve energy localizes the stimulated retinal areas.

It is of further interest to note that in the tests made on the Howard-Dolman apparatus, if a third rod, as a point of fixation, is placed against the back board, the applicant is enabled to place the moveable rod consistently nearer the zero point. Refer to diagram 1.

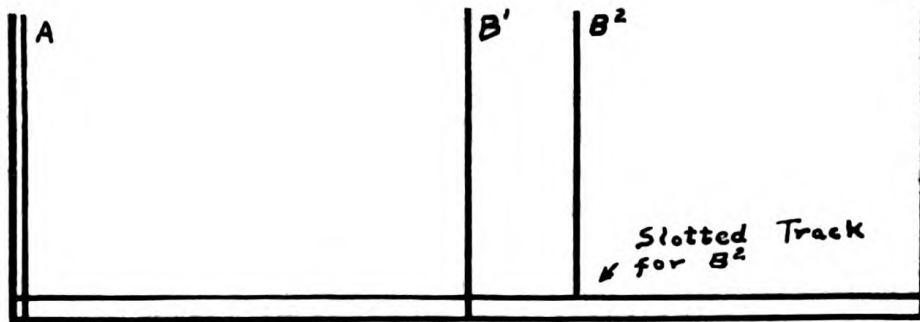
The English have recognized the advantage of the third rod, but the arrangement of the rods is not such as to make the most advantageous use of the underlying principle. A diagram will serve to present the facts noted. Refer to diagram 2.

Let A represent the additional rod on the backboard of the apparatus, for the point of fixation. Let B represent the fixed rod of the apparatus. Let C represent the movable rod of the apparatus, at a greater distance from the observer than the fixed rod B. Let D represent the movable rod of the apparatus, the same distance from the observer as the rod B. With fixation on the point A, images of the point B fall on the noncorresponding retinal areas  $B^1$  and  $B^2$ . Images of the point C fall on the noncorresponding retinal areas  $C^1$  and  $C^2$ . Incidentally, there is crossed diplopia of both the points B and C; and the projected false images of C, at  $C'$  and  $C''$  are less widely separated than the projected false images of the point B, at  $B'$  and

B''. The important fact is that the noncorresponding retinal areas  $B^1$  and  $B^2$ , stimulated by the point B, and the noncorresponding retinal areas,  $C^1$  and  $C^2$ , stimulated by the point C, are more widely separated than the corresponding retinal areas  $A^1$  and  $A^2$ . The specific nerve energy conveys this information to the fusion center, resulting in a sensation of "nearness" for the points B and C in relation to the point A. The noncorresponding retinal areas  $B^1$  and  $B^2$  are more widely separated than the noncorresponding retinal areas  $C^1$  and  $C^2$ .



END VIEW



SIDE VIEW

DIAGRAM No. 1

By the same process, as described above, there results a more acute sensation of "nearness" for the point B than for the point C. Thus, the observer determines that the movable rod C is at a greater distance than the fixed rod B.

If now, with the fixation at the point A, the position of the movable rod is changed to the point D, the same distance from the observer as the point B, we note the incidental crossed diplopia of both the points B and D. We also note that the amount of separation of the projected false images  $B^1$  and  $B^2$  of the point B is equal to



the amount of separation of the projected false images  $D'$  and  $D''$ , of the point  $D$ . The noncorresponding retinal areas  $B^1$  and  $B^2$ , stimulated by the point  $B$ , and the noncorresponding retinal areas

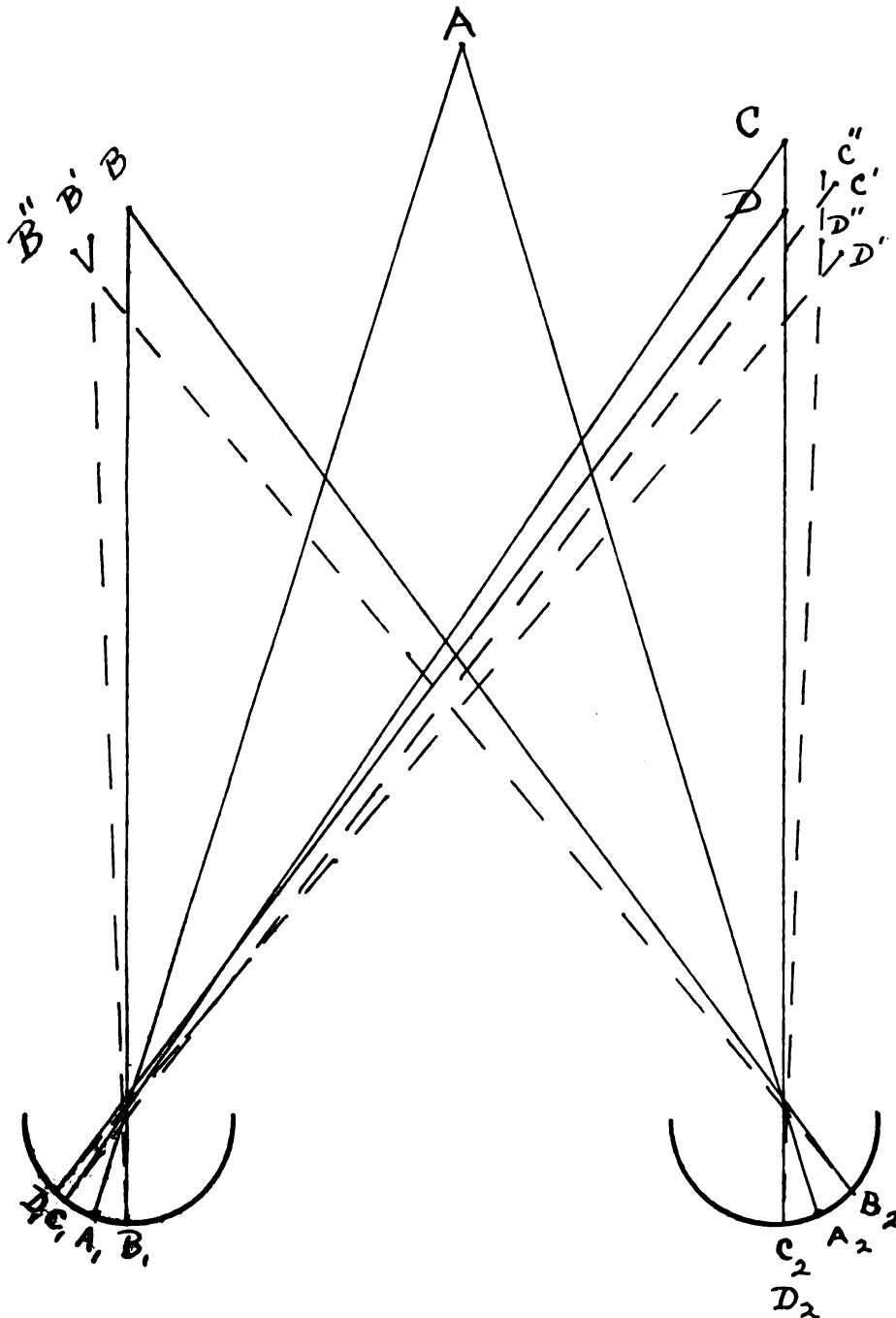


DIAGRAM NO. 2

$D^1$  and  $D^2$ , stimulated by the point  $D$ , are more widely separated than the corresponding retinal areas  $A^1$  and  $A^2$ . There results a sensation of "nearness" for the points  $B$  and  $D$ , in relation to the

point A; but since the retinal areas stimulated by the point B and those stimulated by the point D, are separated by an equal distance, there results the sensation that the points B and D are equally distant from the observer.

By such a method of making the tests on the Howard-Dolman apparatus for depth perception the results are more consistently nearer the zero point. It is a direct test for one of the most useful factors in depth perception. Our present apparatus may be modified so as to give advantage to the applicant and a greater value to the tests.

The acuity of peripheral vision is so small that it is of little value in the determination of details, but by peripheral vision we note the presence, the position, and the direction of the motion of an object in the visual field. The position and the direction of motion of an object in the visual field is determined by specific nerve energy, as applied to the retinal nerve endings. It is this factor which is enhanced by binocular vision in the determination of the relative position of points in the visual field. It is the most important factor in depth determination.

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#### INDIVIDUAL SUBMARINE ESCAPE

By G. H. MANKIN, Lieutenant Commander, Medical Corps, United States Navy

All submarine escape—that is, escape of submarine personnel from a disabled submerged submarine—may be classified under two general heads: Collective and individual. Under collective submarine escape may be considered such methods or devices as will permit the entire personnel to escape together, either by the entire submarine being brought to the surface of the water or one end being lifted by the use of pontoons or by the employment of a diving bell.

It is proposed here to consider individual escape in which each member of the personnel of a disabled submerged submarine makes his way, through his own efforts, to the surface of the water without outside aid.

The question has been raised at various times as to the limit of depth from which free escape could be accomplished without serious personal injury. By free escape is meant escape either through a submarine hatch or torpedo tube without the use of any device providing respirable air to the individual while on his way to the surface. The popular conception is that it is merely a matter of holding the breath, and that, as the average individual can hold his breath about a minute, he would therefore be able to come up through about a hundred feet without difficulty. It is, of course, not such a simple matter as that. We know from actual tests of this

nature carried out at the mine tank at the navy yard, Washington, D. C., that one can come up through 40 feet in 11 seconds when no swimming effort is made and in 8 seconds if one assists by swimming. From information obtained in these tests it was considered advisable to limit such a type of escape to 50 feet, except in extreme emergency. The reason for this will appear later. One must remember that in such escapes the air pressure where the individual is must be built up to balance the water pressure in order that doors or hatches may be opened. Since air volume varies inversely with the pressure, at 33 feet of sea water the air volume would be reduced by half. At two atmospheres (three atmospheres absolute, or at a depth of 66 feet of salt water) the air volume would be reduced to one-third, and so on. It follows that in ascending to the surface the air in the lungs expands with the decrease of pressure, and as the volume becomes excessive the excess must be expelled. As a matter of fact, a point is reached where the expansion is so great that the breath can not be held, and the excess rushes out through the mouth. The writer, through personal experience, has noted in the 40-foot free escape that this point is reached about 10 feet from the surface. The air in the stomach and intestines undergoes similar expansion but is not so easily gotten rid of, and may produce distressing symptoms.

As one nears the surface the speed of ascent increases on account of the increased buoyancy incident to the expansion of the air in the gastro-intestinal and respiratory systems. On a long ascent the expansion of air is necessarily great and a large volume must be gotten rid of. The volume on a hurried ascent increases so rapidly that all of the excess can not pass from the respiratory system, and dangerous intrathoracic pressure develops. These facts were considered sufficient to limit the depths from which free escapes may be made and caused those investigating the subject to seek special means of individual escape in which the ascent is retarded. Methods were sought whereby the excess air could be expelled and the individual provided with respirable air while making the ascent. Another situation which must be borne in mind in submarine escape from great depths is the possibility of the individual suffering from compressed air illness on arrival at the surface if he has been under pressure for some time. By using an apparatus which provides respirable air, one can make the necessary stops for decompression and also expel the excess air from expansion. Several devices of this nature have been developed in the past, but, for one reason or another, have been discarded. Either they were too heavy and cumbersome, or they were physiologically unsound and dangerous to the wearer. The Navy standard rescue breathing apparatus possesses some desirable

features, but it also has a number of disadvantages, principal among which may be mentioned excessive weight, bulkiness, and lack of adequate provision for getting rid of the excess air in the breathing bag during the ascent. This apparatus, however, was really the starting point in the development of the present highly successful type of individual escape apparatus—the “lung.” (See figs. 1 and 2.)

This name has been given to the device because it is short, simple, and not easily confused with the names of other apparatus on board a submarine. Also, the cubic capacity of the breathing bag is approximately that of the human lungs. The “lung” consists of a stockinet covered rubber breathing bag to which are attached two corrugated rubber breathing tubes at the upper border of the bag. They extend up to a valve assembly which automatically directs the flow of air from the bag to the lungs of the wearer and return. Somewhat nearer to the diver’s mouth is a cut-off valve, manually controlled, by which one can close off the air on reaching the surface, permitting the “lung” then to be used as a life preserver. The mouthpiece is attached to this device and is similar to that in use on the earlier gas masks. A good water seal is obtained without conscious effort on the part of the wearer. On inhalation, air enriched by oxygen is drawn from the bag. It passes through a soda lime canister inside the bag, removing the carbon dioxide, then on up through the right-hand tube, the left one being closed off by a mica disk valve in the valve assembly mentioned above. On exhalation, the air passes out through the mouthpiece, the right-hand tube now being closed by a mica disk valve, and down the left tube into the bag, and the circle repeated.

A nose clip is provided to insure breathing only through the mouth. After a small amount of practice, however, the nose clip is found to be an aid but not a necessity. It is of service at times when one is nearing the surface and desires to ascertain his location by looking up. Under this condition water runs into the nose and around the turbinates and produces an uncomfortable sensation if the nose is not stopped off by the nose clip.

At the bottom of the bag is a flutter valve which closes with sea pressure and opens with increased air pressure in the bag. This valve allows the excess air produced by expansion in the body, and in the bag during the ascent, to escape.

On the anterior flat surface of the bag is a valve and valve stem identical to that found on the inner tube of an automobile tire. Through this valve the bag is filled with oxygen prior to the escape.

Two fabric straps are used in fastening the “lung” to the wearer. One strap secured in loop fashion to the upper corners of the bag



FIGURE 1.—THE "LUNG." (BUREAU OF CONSTRUCTION AND REPAIR)

20-1



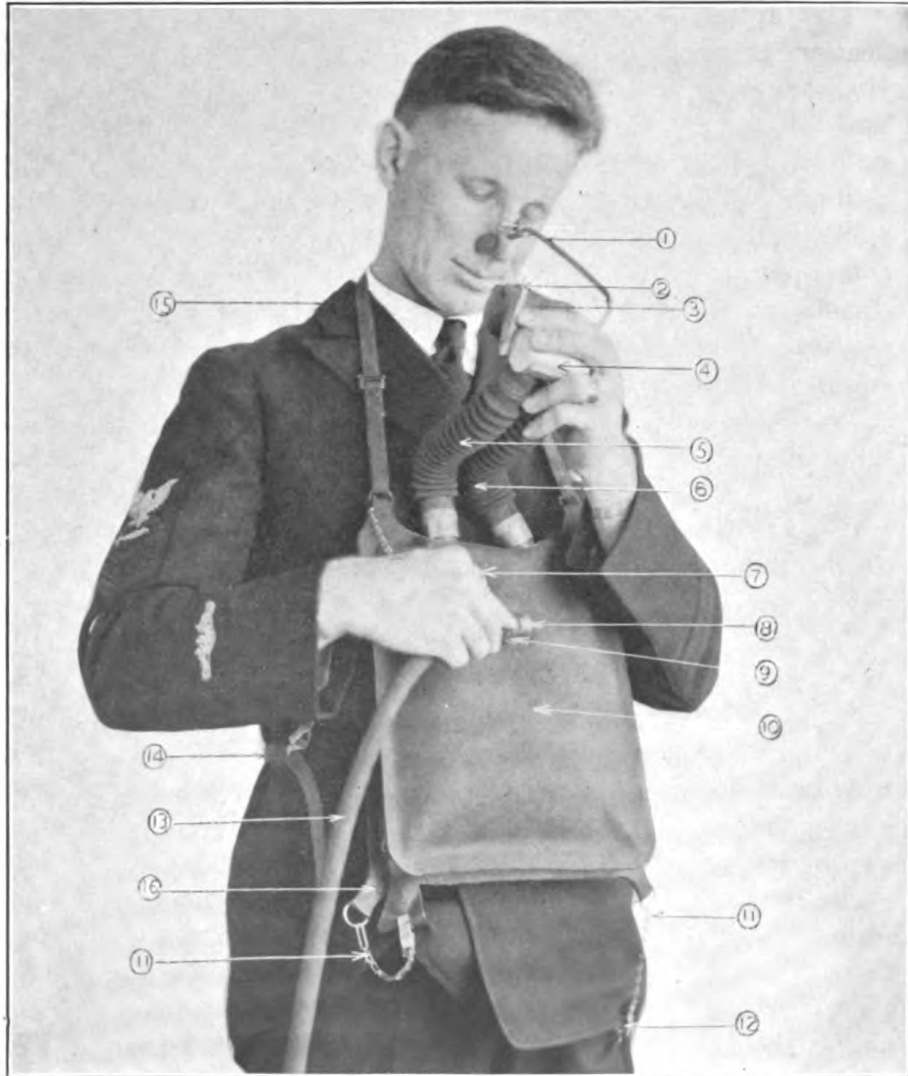


FIGURE 2.—(BUREAU OF CONSTRUCTION AND REPAIR)

- |                               |                                    |
|-------------------------------|------------------------------------|
| 1. NOSE CLIP                  | 9. OXYGEN INLET VALVE              |
| 2. SHUT-OFF VALVE             | 10. CANISTER (INSIDE OF BAG)       |
| 3. RUBBER MOUTHPIECE          | 11. CHAINS FOR HOLDING-DOWN CLAMPS |
| 4. METAL MOUTHPIECE (HOUSING) | 12. HOLDING-DOWN CLAMPS (TROUSERS) |
| 5. INHALATION TUBE            | 13. OXYGEN HOSE                    |
| 6. EXHALATION TUBE            | 14. BELT STRAP                     |
| 7. CANISTER FILLING CAP       | 15. SHOULDER STRAP                 |
| 8. AIR CHUCK ON OXYGEN HOSE   | 16. RELIEF VALVE (FLUTTER)         |

20—2

passes around the back of the neck. The other strap is attached to the sides of the bag and passes around the waist. Two metal clips secured to the lower corners of the bag are used to fasten the bag to the trousers or bathing suit and prevent the inflated bag from floating upwards.

The apparatus described above is the result of many modifications based upon experiments under all possible conditions. Credit for its development is due Lieut. Charles B. Momsen, United States Navy; Frank Hobson, civilian engineer in the Bureau of Construction and Repairs; and Clarence Tibbals, chief gunner, United States Navy. Lieutenant Momsen is a submarine officer of exceptional ability and long experience. His belief in the possibilities of the apparatus, as well as his courage to test the device under all conditions, were the outstanding forces in developing the "lung" and winning for it universal submarine service recognition and final adoption.

Mr. Frank Hobson's familiarity with all types of rescue breathing apparatus, as well as his engineering skill, were important influences in the designing of the "lung."

Chief Gunner Clarence Tibbals's long and varied experience in deep-sea diving and salvage operations made him invaluable in the development of this escape apparatus.

The first tests were carried out in the model basin at the navy yard, Washington, D. C. The depth used was not greater than 15 feet during the first month. The reactions and experiences of those using the device were carefully noted and recorded. Alterations and modifications were made as suggested by use and experience. These experiments were then continued in the mine tank, where greater depths were to be had.

A diving bell was constructed so that those testing the apparatus might descend to greater and greater depths. The crude but satisfactory bell consisted of an inverted wooden tub with uprights extending below and joined by a crosspiece upon which the divers could stand while being lowered to the various depths. Lead weights were attached to the crosspiece for ballast and to maintain the bell in proper position. The men conducting the tests stood on the crosspiece, mentioned above, with their heads inside the inverted tub and were lowered to various depths, beginning with 20 feet. Air under pressure was supplied to the bell during the descent. On reaching the required depth the men donned the "lung," filled the bag with oxygen from a flexible rubber hose let down through the water, adjusted the mouthpiece and nose clip, and then ducked out of the tub and started their ascent. To retard the speed of the ascent the men held on with hands and feet, to a line attached to the bell. They

were encouraged to ascend slowly. Gradually the depths used were increased to 60 feet, the depth of the tank. Untrained personnel were then given opportunity to use the "lung" and make escapes from various depths up to that of the tank. It was gratifying to note that one could easily learn to use the device, and that escapes with it were as easy for the novice as for the trained diver. It is not even necessary to know how to swim.

The apparatus was tested at greater depths, using the pressure tank at the diving experimental station, navy yard, Washington, D. C. This tank is cylindrical in shape and is about 20 feet deep and 12 feet in diameter. It is closed at the top by an air-tight pressure hatch permitting the pressure to be increased to correspond to any depth required for the test. It is provided with a complete high pressure air system with air compressors, gauges, volume tanks, and control valves. The tank is two-thirds filled with water. To simulate escape from a given depth, the subject enters the tank, the steel door is closed, pressure is applied, under control of the diver, to the amount equal to the depth of water from which it is desired to make an escape. The subject then adjusts the "lung" and ducks under the water. Weights are necessary to hold the diver under the surface of the water. The pressure is now released through outside control at the same rate it would be naturally in ascending through actual water. Using this method, escapes were made from depths up to 250 feet. Stops were made at various pressures during the ascent to properly decompress the subject and thus avoid compressed air illness (caisson disease).

It then seemed desirable to continue tests in open water, and for this purpose the old diving boat *Cirilley* was obtained. Off Morgantown in the Pawtuxent River we found a spot where the water was 110 feet deep. Using a diving bell of the same general type as previously mentioned, but of steel and square in shape, two divers with a tender were lowered to the bottom and made successful escapes to the surface. Similar tests were made at a depth of 155 feet off Solomon's Island in Chesapeake Bay. All of these open-water tests were entirely successful and were made without discomfort to the personnel either at the time or subsequently.

At this period in the development of the escape apparatus, permission to use the U. S. S. *S-4* for further tests was granted by the Secretary of the Navy. This ship, sunk in collision off Provincetown and subsequently salvaged, was recommissioned as an experimental submarine hulk. The propulsive machinery, such as electric motors and Diesel engines, was removed from the ship. All auxiliary machinery was concentrated in the central operating and battery compartments. The compressed air banks, kingstons, vents,



periscope, and other apparatus for controlling the vessel during stationary dives were retained on board.

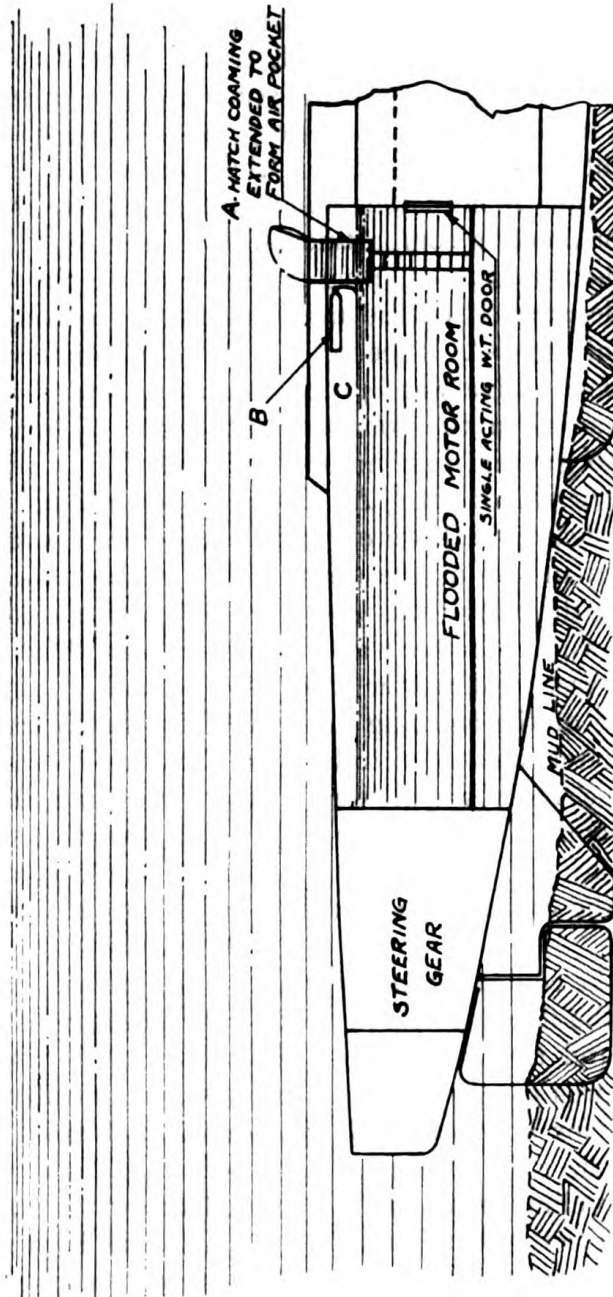
Escapes were made from the torpedo room, engine room, and motor room with the *S-4* submerged at depths of from 40 to 206 feet in the open sea off Key West, Fla.

The only noteworthy changes required in the hull or fittings of the *S-4* were: First, extension of the hatch trunk down into the motor room 2 or 3 feet below the overhead; second, the installation of a partial bulkhead in the torpedo room to provide an air pocket when the compartment was flooded; third, the attachment of an escape lock over the engine room hatch; and fourth, the installation of 9-inch sea valves for flooding compartments.

An idea of the method used in escaping from the submarine may be obtained from a description of the measures taken in escaping from the motor room of the *S-4*. (See fig. 3.) First, the hatch was undogged; then the flood valve was opened, admitting water from the sea. The air pressure in the compartment began to increase but the increase was so gradual that no one had difficulty in equalizing the pressure on the ear drums. As the air pressure continued to increase, the hatch began to leak water. At first there was a small stream which increased in size as the air pressure in the compartment went up. When the water was about the level of the knees the stream coming down the hatch was about a foot in diameter. This grew to about 2 feet in diameter when the water had almost reached the lower edge of the coaming or skirt of the hatch trunk. The free edge of the hatch was noted to be open about 6 or 8 inches admitting a dark blue light which was sunlight filtering down through the Gulf stream. There was no unpleasant sensation during the flooding operation. The rush and roar of water coming down the hatch into the confined space made conversation difficult but not impossible.

When the water in the compartment advanced 1 or 2 inches up on the side of the trunk, the flooding ceased because the pressure of the air in the air space and that of the sea water outside were just balanced. The trunk was completely filled with water and all was perfectly quiet except for an occasional oscillator signal from the U. S. S. *Mallard*, rescue ship, standing by overhead. Then some one wearing a "lung" climbed up the ladder and threw the hatch wide open and returned to the compartment. A small cork buoy was passed up the hatch. One end of a signal halyard was attached to the buoy and the other end was secured in the boat. Wooden ball markers attached to the line every 10 feet from the buoy down to 70 feet marked stopping points for decompression on the deeper escapes.

Everything was now prepared for the escape. The individual donned the "lung," charged the bag with oxygen from a cylinder located in the compartment, adjusted his mouthpiece and nose clip, ducked under the hatch skirt, or coaming, grasped the buoy line and



**MOTOR ROOM OF S-4**  
SHOWING—  
(A) HATCH WITH COAMING (APRON) EXTENDED TO FORM AIR BUBBLE  
(B) OXYGEN FLASK WITH CHARGING HOSE  
(C) AIR POCKET FORMED AROUND HATCH COAMING BY FLOODING COMPARTMENT

allowed himself to slide up, checking his ascent by holding to the line and by wrapping his legs around it. Stops, according to a pre-arranged schedule or table were made at various distances from the surface. In the absence of any mechanical means of counting time,

the respiratory rate was used as a means of determining the length of each stop. The respiratory rate of 16 per minute was taken as normal. Accordingly, if a stop of one minute was required by the table, the one making the escape would check his ascent at the proper depth for 16 complete breaths or 32 breaths when two minutes were required, and so on. This proved to be a satisfactory method and had the additional advantage of giving the diver something besides the large and vicious fish he is likely to encounter, to think about.

Decompression times were short owing to the brief exposure to high pressure. The 100-foot escape required but five minutes and there were no after effects. The recompression chamber of the U. S. S. *Mallard* was held in readiness to receive any one suffering from compressed-air illness.

For escapes from depths of over 100 feet the small escape lock attached to the engine-room hatch was used because of the small amount of water required to flood it. The personnel were here not under pressure for such a long period of time as in the case of flooding an entire compartment. More important, however, was the fact that the submarine could be brought to the surface with the escape lock flooded, but with an entire compartment flooded it would be impossible to do this until the compartment had been unwatered. During the preparations for one of the escapes from deep water the wisdom of using the small escape lock was proven. The *S-4* was on the bottom and two men had gone from the engine room into the small escape lock when the periscope packing gave way at one point and a stream of water about an inch in diameter came into the control room. It would not have mattered greatly if it had not been directed toward the electrical switchboard. The danger of a short circuit was very real.<sup>1</sup> Lieutenant Ives, in command of the *S-4*, ordered the boat brought to the surface at once and before a short circuit actually occurred. The escape lock placed on the engine-room hatch was installed for the experimental escapes only. It is not contemplated that submarines will in the future be so equipped. It interferes with the diving performance and maneuvering of the ship. It is planned to equip the engine-room trunk with a skirt similar to that provided for the motor room, and escape will be performed in the manner prescribed for that compartment.

The escape lock, placed on the engine-room hatch for these tests, was a steel cylinder about 8 feet high and 4 feet in diameter. The upper end is closed and securely bolted down. There was a door of water-tight construction on the after side. The door could be undogged from the inside or outside by a single lever. The top of

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<sup>1</sup>This type of accident is believed to have driven the control-room personnel out when the *S-4* was rammed off Provincetown.

the door is 18 inches from the top of the cylinder, providing an air space for the personnel during the process of flooding. Not more than five persons can conveniently get into the lock at one time. Necessary valves for control of flooding and venting, a compressed-air line, an oxygen cylinder, and the buoy and marked line are installed in the lock. Entrance to the escape lock is made through the engine-room hatch, which is then closed. Exit from the lock is by way of the side door, mentioned above. Flooding of a compartment or the lock was more quickly accomplished at greater depths on account of the higher pressures.

It is understood that plans contemplate the future equipment of all submarines with two of the "lung" type escape devices for each person on board. One will be stowed in each end of the ship, so that no matter where the submarine is struck, the individual will be assured of an escape apparatus for his use.

In recent tests of the "lung" in the pressure tank at the navy yard, Washington, D. C., two divers ascended from a depth of 357 feet without the slightest discomfort or unpleasant aftereffects. This involves a pressure of nearly 159 pounds above atmospheric pressure, or, roughly, 174 pounds, absolute, per square inch. Considering that the body surface of the average man is approximately 2,000 square inches, it will be seen that the total pressure applied on the body of the diver was 174 times 2,000, or 348,000 pounds, absolute (i. e., gauge plus atmospheric), an enormous pressure when considered in the abstract. It must be remembered that under normal atmospheric conditions the body is subjected to roughly 29,400 pounds (14.7 by 2,000). This pressure is exerted equally over the entire body and the inside of the body is under the same pressure as the outside in the same manner as the inside of a submerged sponge has the same pressure as the outside of the sponge. Thus there is no cupping effect as in the diving accident known as the "squeeze." Ordinarily the air pressure in a diver's suit is maintained at about 2 pounds above the pressure of the outside water. If for any reason the pressure in the helmet drops below the pressure of the outside water, even so small amount as a pound, there is an unopposed pressure, the amounts depending on the disparity between the two pressures. In the example just given where the pressure within the helmet is 1 pound below the outside pressure, there is an unopposed pressure of roughly 2,000 pounds (1 by 2,000) tending to press the diver up into the incompressible helmet. This is the most feared accident in diving. Falls from one depth to a lower one, without the diver having opportunity to increase the pressure in the suit, provide the conditions necessary for a "squeeze."

The exact limiting depth from which escape may be made with the "lung" has not been determined. Analyses of the residual air

in the bag have been made after escapes and there has always been found sufficient oxygen remaining to support life, even at atmospheric pressure.

It is well in this connection to remember that the physiological effects of gases are best measured by their respective partial pressures rather than by their percentages. For example, 10 per cent of oxygen at two atmospheres pressure, absolute (i. e., atmospheric plus one atmosphere gauge), has the same physiological effect as 20 per cent oxygen at atmospheric pressure, and 10 per cent oxygen at three atmospheres pressure, absolute (i. e., atmospheric plus two atmospheres gauge), has the same physiological value as 30 per cent oxygen measured at sea level.

Five per cent oxygen at sea level is too low to support life, but at four atmospheres gauge, which equals the pressure at a depth of 99 feet, sea water) the normal requirements for oxygen are satisfied by this percentage. Advantage is taken of this principle in escapes made with the "lung" when the tidal air from the lungs instead of oxygen is used to inflate the apparatus. Escapes under these conditions have been made from depths as great as 110 feet with excellent results. At present it seems desirable to cease breathing the air from the "lung" when a point at 20 or 30 feet from the surface is reached, coming then directly to the surface as in the free escape, because the partial pressure of oxygen in the bag may be approaching the lower limit compatible with life. There is no danger or discomfort in a free escape from 20 or 30 feet. Further tests, using the tidal air, are contemplated.

While increasing the pressure necessarily increases the partial pressure of oxygen and makes a smaller percentage more effective physiologically, the same thing is happening to the carbon dioxide content of the air. One per cent of carbon dioxide in the air at three atmospheres pressure, absolute, has the same physiological effect as 3 per cent at atmospheric pressure. This percentage causes no distressing symptoms unless one attempts physical effort. It then produces deep and rapid respiration, rapid heart action, fatigue, and, after a time, headache. Thus if an S-type submarine, which has been cruising submerged for 10 or 12 hours, is sent to the bottom as a result of a collision, and has, perhaps, 2 per cent carbon dioxide in the air at atmospheric pressure, the application of further pressure must be carefully supervised. If she is lying in 112 feet of water, for example, the pressure on the hull will be equal to five atmospheres, absolute. The 2 per cent carbon dioxide will, when the compartment is flooded preparatory to escape as mentioned previously, be the equivalent physiologically of 10 per cent carbon dioxide at sea level.

Textbooks vary greatly as to the lethal concentration of carbon dioxide. The figures vary from 9 to 25 per cent. It is believed that 10 per cent is very close to a lethal concentration. This figure was used by the writer in calculating the length of time the six persons in the torpedo room of the *S-4* would live when that ship was on the bottom off Provincetown. As near as could be ascertained, the estimate of 72 hours was approximately correct. Lieut. Charles B. Momsen, United States Navy, one of the inventors of the "lung," and the writer carried out an experiment in the recompression chamber at the diving experimental station, navy yard, Washington, D. C., to determine the effect of 2½ per cent carbon dioxide under four atmospheres pressure, absolute, or about the pressure on the hull of the *S-4* when that vessel was on the bottom off Provincetown. This is equivalent to 10 per cent carbon dioxide at sea-level pressure. It was planned to drop the pressure in the chamber when the effects of the carbon dioxide became intolerable. Oxygen-rescue apparatus was carried into the chamber for emergency use. The symptoms became so pronounced after nine minutes that it was necessary to don the breathing apparatus, and it required about a dozen respirations of pure oxygen to wash out the carbon dioxide in the lungs and tissues and to relieve the mental and physical symptoms. The pressure was dropped to 30 pounds gauge (approximately three atmospheres, absolute) and the oxygen apparatus removed. It was still extremely uncomfortable, but it was tolerable. The discomfort decreased as the pressure was lowered to zero gauge. It will be necessary to take into account the effect of even small percentages of carbon dioxide when making escapes from a submarine sunk at a considerable depth. It will be required, perhaps, that "lungs" be filled with oxygen and worn at the beginning of the flooding operation, when the partial pressure of carbon dioxide may be high, due either to a high percentage or to the great depth at which the submarine is lying.

It is felt that submarine personnel may now enjoy much the same sense of safety that is felt by the personnel of surface craft, since there is now available a proven method of individual escape without reliance upon outside aid. Instruction is being given to all officers and men passing through the Submarine School at New London, Conn., as to the proper method of using the escape device. A large 100-foot tank is being constructed there to assist in making the personnel familiar with all the details of submarine escape. A compartment in the bottom will be similar in all respects to a submarine compartment. Small air locks at various depths will be used for preliminary escape instruction.

URETERAL STONE<sup>1</sup>

By E. L. MERRITT, M. D., Fall River, Mass., Lieutenant, Medical Corps, United States Naval Reserve

From the very beginning of medical history the attention of physicians has been directed toward a solution of the mystery regarding the formation of stones within the human urinary tract. Until the cause of this formation can be definitely ascertained, steps toward prevention are futile. But meager accounts have appeared in the literature regarding certain brilliant results attained by investigators in physical and colloid chemistry and yet it would appear that these results point the way to the ultimate solution of the problem.

It is probable that geographic locations, water supply, heredity, diet, occupation, and trauma play but a small part in the process, and we have left but two familiar factors, stasis and infection.

If stasis alone were responsible, then we should expect to find stone in practically all cases of hypertrophied prostate, stricture, and hydronephrosis. If infection alone is responsible then stone should be found in all cases of pyelonephritis, pyonephrosis, and renal tuberculosis. On the other hand, we must all admit that vesical, ureteral, and renal calculi are often encountered when apparently neither stasis nor infection is present. Without question, stasis and infection are contributing factors, but we must look further for a more definite cause.

Spitzer and Hillkowitz in a paper several years ago pointed out that the salts of the urine are kept in supersaturated solution through the agency of the colloids of the urine. Presence of other colloids of opposite electrical charge will neutralize the power of the protective colloids to hold the salts in solution; thereby allowing the latter to crystalize out.

Most stones are formed by the combined precipitation of colloids and crystalloids. That there is some organic binder present in stone has been known for some time, and these writers tell us that this binder is a framework on which the inorganic crystalline structure is built. It consists essentially of irreversible colloids that have been thrown out of suspension. The chief characteristics of a urinary stone are its firmness and the concentric stratification which is frequently marked by a radial arrangement of the crystals. Experiments by Schade demonstrate that the concentric arrangement of the layers of stone is the result of the simultaneous precipitation of crystalloids and colloids. This investigator has successfully reproduced by artificial means in the laboratory calculi similar in arrangement to those found in the urinary tract.

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<sup>1</sup> Read at the February, 1929, staff meeting, U. S. Naval Hospital, Newport, R. I.

Clinically we should expect to find pure crystallized stones in urines where there is no inflammation and no pathologic colloids. Stasis would favor this type. On the other hand, the usual mixed colloid and crystalloid variety, being more apt to form in the presence of colloids, would be favored by the presence of infection.

Any pathological process, such as obstruction to the outflow of urine or faulty metabolism, can throw the delicately balanced colloids out of equilibrium and thus create the starting point for stone formation.

Many investigators have written regarding the chemical composition of urinary calculi, and in the earlier work the authors considered uric acid and urates as the most important constituents of urinary stones. A review of the literature discloses that various authors differ as to the percentage of calculi containing these constituents.

Thompson-Walker notes that out of 649 urinary calculi in the Hunterian Museum, 74 per cent contained uric acid or urates. Dickinson, in an examination of 91 renal stones, found uric acid or urates in 70 per cent, and 63 per cent of them contained calcium oxalate. Kuster, on the other hand, in an examination of 511 urinary stones found uric acid and urates in only 3 per cent of them, and in this series phosphates were present in 31 per cent, oxalates in 22 per cent, and xanthin in 3 per cent. Ultzman, in a series of 545 stones, found uric acid in 81 per cent, calcium oxalate in 5.6 per cent, and phosphates in 1.4 per cent. It is the opinion of Bence-Jones that 75 per cent of all renal calculi are uric acid.

The chemical composition of renal and ureteral calculi is exceedingly important from a diagnostic standpoint, as many stones are negative to the Röntgen ray. The relative opacity of a urinary stone depends on the total molecular weight of its constituents and is influenced by its structure and thickness. Some urinary stones having constituents of low molecular weight are negative to the Röntgen ray. These include stones composed of uric acid, urates, and triple phosphate. The Röntgen ray alone is not sufficient to diagnose urinary calculi in early formation, especially those in the ureter. Cystoscopy and urography should be employed to aid in the early diagnosis before the deposits of calcium salts in the calculi occur. It is a fairly safe rule that the greater the calcium deposit the older the stone.

Every case of abdominal pain, I believe, should be X rayed, and if symptoms warrant it, cystoscopy should be done.

Caulk reports a large series of kidney cases in which 27 per cent of patients with renal and ureteral stones had had previous appendectomies, without relief. X ray alone would have cut this num-



ber in half and cystoscopy with urography would have further reduced the figure.

It has been estimated that from 2 to 5 per cent of renal and ureteral calculi are negative to the Röntgen ray, and for this reason Caulk recommends that the Röntgenologist never use the expression "The X rays are negative." He believes that in these cases where the plates show no evidence of stone and the report is given in this way, both the patient and the family physician immediately take it for granted that the renal system can be ruled out as a possible cause of the pain. Caulk advocates that the Röntgenologist report the plates as showing no definite evidence of stone. In this way the mind is not diverted from other possibilities which might exist in the renal system.

A possible source of error in the accurate diagnosis of ureteral stone is the presence of phleboliths in many patients. The finding of small round stonelike concretions in veins aroused the interest of anatomists and pathologists at an early date. Canstatt, in 1843, reported a case in which he found phleboliths in the splenic vein. Other writers through the years reported the finding of phleboliths in many patients, and in 1911 Wydler probably gave the best microscopic description of phleboliths ever written.

With the discovery and the widespread use of the Röntgen ray the interest in phleboliths took on renewed vigor because they began to have a very definite clinical significance. The shadows were often diagnosed as ureteral calculi but the frequency of the mistake eventually made the surgeons more wary.

The cause of these shadows in pelvic Röntgenograms was not definitely settled until 1908, when Clark and Orton, working independently, were able to prove conclusively that they were due to phleboliths. Clark, in one post-mortem examination, found 18 phleboliths. Röntgenograms of the pelvis revealed the presence of multiple shadows. He removed all the pelvic organs and tissues and placed them in position on a skeleton after inserting stilettes in both ureters. Röntgenograms showed the shadows still present but not in line with the shadows of the stilettes. Röntgenograms of the plexus containing the phleboliths gave exactly the same shadows as appeared in the original plates. This excellent work proved that the phleboliths were the cause of the shadows. It soon became known that phleboliths and ureteral stones cast similar shadows, and the aid of the cystoscope and stilette or lead catheter was necessary before an accurate diagnosis of ureteral calculi could be made. To-day phleboliths are not only of great importance to Röntgenologists and urologists but also to internists and surgeons, and their shadows should immediately suggest the need of a urological examination when a history of uretral disease is obtained.

In a series of 1,555 consecutive Röntgenograms of the pelvis at the Mayo clinic shadows of phleboliths were observed in 38.99 per cent.

Rokitansky and Balogh tell us that phleboliths are composed chiefly of calcium, magnesium, and iron in the form of carbonate and phosphates, and it is probable that they grow from a central nucleus which arises in a thrombus. In the series before referred to at the Mayo clinic the shadows were two-thirds as common in females as in males and 47 per cent of the phlebolith shadows were bilateral. They vary in size from 1 to 10 millimeters in diameter, and they are found most commonly in the periprostatic plexus of males and in the uterine plexus of females.

Röntgenologists can determine whether calculi are extra or intra-urinary in about 94 per cent of cases of pelvic Röntgenographic shadows. Urologists should be able to identify all pelvic shadows as extraurinary or intraurinary. The lead catheter alone is unreliable in locating pelvic shadows and urography is to be recommended.

Since gynecologists have been using lipiodol injections for demonstrating tubal patency, it has been shown that this material persists within the abdominal cavity for months and probably years. This fact must be borne in mind when suspicious shadows are seen during the search for ureteral calculi.

It is probable that the great majority of ureteral calculi are passed spontaneously, and we must realize that a considerable number of patients having renal colic and passing a calculus never even see a physician.

We are particularly interested, however, in those ureteral calculi which do not pass spontaneously, and we are chiefly concerned with the method to employ in freeing them. We must consider their size, shape, location, and degree of fixation. It is also well to know whether or not renal infection is present, the separate renal function, the degree of hydronephrosis and hydroureter, the amount of discomfort, and the age and general condition of the patient. Blood chemistry is of great value in determining the degree of renal damage.

For many years ureteral stones have been removed by intra-ureteral manipulation through the cystoscope, but it has been only within the last decade that the methods used have gained the recognition they deserve. Bransford Lewis first demonstrated the method of ureteral dilatation, and later Cröwell, Livermore, Rathbun, Dourmashkin, Bumpus, and others have added certain important points to the technique.

The cystoscopic removal of ureteral calculi consists in dilating and paralyzing the ureter. This dilatation can be accomplished by the insertion of multiple catheters or bougies or by the use of dilating

instruments such as those designed by Livermore, Stirling, Cecil, and Vose. It has been my experience that this dilatation can best be accomplished under general or caudal anesthesia. Local anesthesia injected into the ureter has not been satisfactory in my hands. I do not believe that any one rule can be laid down as to the best method. In some cases it has been my custom to dilate the ureter with multiple catheters, in others to slit the ureteral orifice with the Bumpus scissors, and in still other cases to rely on oil injection alone. I have never employed metal dilating instruments and feel that they can do much harm to the ureteral mucosa if not handled properly. I have had some degree of success with Bumpus's method of inserting as many catheters as possible beyond the stone, and then by twisting them, snare the stone, and remove it within the meshes of the catheters. Some urologists are enlarging the ureteral meatus by a high frequency current. In the majority of cases I have not been successful in actually removing the stone at the time of manipulation, but in over 90 per cent of my cases I have succeeded in so changing the position of the stone that with the ureter dilated and oil injected the patient has very soon passed the stone. My shortest elapsed time in these cases has been two hours, the longest three weeks.

There are, of course, some ureteral stones that resist all efforts at manipulation and must be removed by open operation. Except for those cases of calculus anuria where every minute counts and in those patients having marked infection, the necessity for open operation is rare.

Hunner is probably right when he states that the presence of a calculus in the kidney or ureter is presumptive evidence of a coexistent ureteral stricture. With the knowledge gained from the study of ureteral stricture and the part it plays in the patient's symptoms, in the future we shall seldom operate as an emergency measure on patients with stone in the ureter. By instituting proper drainage with the ureteral catheter we can, in the vast majority of instances, tide over the emergency and choose our own time for operation should it become necessary later on.

Ureteral obstruction, far from being a rare pathological curiosity, is an extremely common cause of abdominal pain. As in any other diagnostic problem, careful history taking and study of the clinical symptoms, together with Röntgenological and cystoscopic examination, should be the watchword.

A better appreciation of the clinical picture of ureteral stone and the knowledge of the value of cystoscopic treatment will, I believe, save many patients from much empirical surgery.

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**THE RATIONAL TREATMENT OF HEMORRHOIDS**

By R. B. MILLER, Lieutenant Commander, Medical Corps, United States Navy

The fundamentals which underlie a rational hemorrhoids therapy are well established and satisfactory treatment is now possible in the majority of cases in which a judicious application of existing principles is made. A choice of methods not wisely adapted to the indications presented is frequently responsible for the undesirable terminations still to be observed. The minor nature of the lesion and the favorable condition of the patient often permit of acceptable end results from any of a number of procedures, but considerable discrimination in the selection of methods is often essential to success where the involvement is extensive or the general condition of the patient unfavorable.

Any analysis of present-day hemorrhoids therapy should make due allowance for the evident distinction that exists between generalized and specialized practice. The former does not reflect all that it might of recent advances, and the persistence of certain methods in general work, despite developments which tend to condemn their usage, has occasioned a not unmerited measure of criticism from the proctologist. Even a casual survey will, however, bring into prominence a number of factors which contribute largely to prevent the ready

adoption of many of the newer procedures by the general practitioner.

Not all of the measures utilized by the specialist are, for example, well suited to general adoption. Refinements of technique in individual hands often permit of success with methods which in other circumstances are apt to prove disappointing. The absence of any well-defined uniformity of opinion among proctologists respecting methods of choice throws a number of additional confictions in the path of the general practitioner. There also exists a limited but distinctly evident group of cases for which modern proctologic practice offers little by way of substitution for that which it condemns.

It would be as difficult to effect as it would be unwise to seek any standardization of procedure for all occasions. The variation in the types of lesion encountered as well as the diversity of indications presented by the general condition of the patient endanger the success of such a course. The best practice has come to be recognized as that in which the choice of method most adequately meets the indications encountered. The general practitioner must therefore avoid the possibility of becoming too deeply intrigued by the virtues of any single method.

Individual experience and preference will probably always militate against the general acceptance of any formulated group of procedures for the treatment of hemorrhoids. No group of selections could in any event be designated as ideal, if modern surgical desiderata are the accepted bases for approval. It is possible, however, in view of existing principles, to select a group of procedures from among those in current use that may be considered to constitute a rational, if not an ideal outline for general adoption. Modern advances, as represented by proctologic practice, are the consequence of elimination as well as innovation, and the value of any outline for general use must likewise depend largely upon that which is omitted as well as that which is recommended for adoption.

The following discussion is an attempt to help clarify the status of a number of procedures now in common use and to assist in a determination as to what constitutes a practical as well as an acceptable therapy for the general practitioner. A discussion of two methods that have proved particularly satisfactory in the hands of the writer will also be presented in the hope they may prove interesting and perhaps helpful to others.

External hemorrhoids offer few problems of consequence in ordinary circumstances, and the present discussion is concerned with the internal variety of tumor only.

## NONSURGICAL PROCEDURES

Opinion has long favored a conviction that the treatment in a majority of cases is properly surgical. The tendency in many quarters is now, however, toward conservatism (so called) whenever this is possible. The activities of quacks and charlatans with respect to a popularization of a belief in the desirability of the nonsurgical removal of hemorrhoidal tumors have unquestionably created a more widespread demand for nonoperative procedures. It is difficult to estimate to what extent this has led to an increase in the application of nonsurgical measures, but it is safe to assume that such factors have had no inconsiderable influence in this direction. Dunne (1) estimates that only 50 per cent of cases demand surgical attention, and Crockell (*ibid.*) agrees that half of the internal tumors may be cured without operation. These views are based upon specialized experience; and while it is perhaps true that only 50 per cent of cases demand surgical attention, it is equally certain that a much larger proportion should be so treated in general practice. Many of the nonoperative procedures not only require a special experience to assure the best results, but several of them are not entirely safe in untrained hands. The elimination of the causative factor, whenever this is possible, constitutes an essential part of the management of all cases, and appropriate treatment must, of course, be directed toward this end.

Among nonsurgical procedures, that of Wilson (2), which attempts to "reeducate" the sphincter when the piles are due to a loss of tone in this muscle, is perhaps as conservative as any to be found. The patient is instructed to voluntarily contract the sphincter a number of times each day for a period of days or weeks. Such a measure obviously has a limited scope of application, and, as might be expected, no great popularity.

The various electrical methods have thus far enjoyed no widespread employment, although good results are reported by a number of devotees to this branch of therapy. Desiccation, ionization by simple galvanism, galvanocautery or galvanopuncture, electrocoagulation, etc., are among the more popular measures in use. Dunne (1) believes that electrolysis merits more attention than it has thus far enjoyed and reports considerable success with the measure over a period of years. Several of these methods undoubtedly permit of very satisfactory results under favorable circumstances. They, however, require some special experience as well as special equipment and are all open to the common disadvantages of limited scopes of application and frequently protracted courses of treatment. Those methods followed by sloughing, as is the case with diathermy, are especially objectionable.

Montague (3) reports the use of radium in selected cases. He implants four to five radium emanation seeds along the base of the tumor and claims that fibrosis is induced in four to five days. The application of radium is, of course, not, however, suited to general adoption.

The majority opinion has long regarded the destruction of hemorrhoidal tumors by the frequently painful and occasionally dangerous procedure of corrosive injections into the mass with disfavor. This method, which has been in use for more than half a century, is occasionally complicated by sloughing, dangerous infection, or violent pain. Phenol has been and probably still is the most efficient agent for this purpose. But its use is responsible for most of the objections leveled at this procedure. Cresylic acid and glycerin are less dangerous but not as effective. Quinine and urea chloride are relatively painless and much safer than phenol. Terrell (4), who has been a staunch advocate of the former for years, believes the measure is gaining friends. He admits the procedure has limitations and recommends its use in simple and uncomplicated cases only. Numerous others warmly recommend the measure, and there is no question but that the injection of quinine and urea has a definite place in the therapy of hemorrhoids. It must, however, be used with caution by inexperienced hands and, as Terrell further points out, the treatment in the occasional case may need to be continued over a period as long as 12 to 14 weeks.

In any interview of nonoperative procedures it is soon apparent that the injection method offers greater possibilities for general usefulness than any other. Many of the measures in this category require special apparatus as well as special experience. The injection method requires little of the former and less of the latter than most. With the elimination of phenol and the adoption of quinine and urea this measure becomes at once a safe and highly effective procedure—under proper auspices and within its limitations. But it is not as rapid or as certain as operation. The course is liable to undesirable protraction, recurrence is common, and the scope of application is restricted. There are cases in every practice in which the use of this measure can not be criticized. But there are no cases in which its use is indicated solely on the basis of the end results to be achieved. Those who examine the reports of its application are apt to obtain the impression that its use is largely a matter of convenience. There is no good reason why such a consideration should not prevail in the simple and uncomplicated cases, perhaps; yet the physician should not permit himself or his patient to lose sight of the proper status of the procedure. It can not replace operative measures in advanced and complicated cases, nor can it afford such rapidity, certainty, and permanence as surgical removal, even in the simpler involvements.

## SURGICAL MEASURES IN GENERAL

Ligation without excision and cauterization without the clamp are among the most ancient of surgical methods used in the treatment of hemorrhoids. The latter is not, of course, in present-day use. The former is now rarely employed and should be condemned in most instances. Infection of the resultant slough is invited, the duration of the process is unnecessarily protracted, and discomfort is apt to be marked. Bodkin (5a) states that while the ligature usually cuts through in five to seven days, this may not occur for three weeks or so if the piles are large or hypertrophied. He believes that this complication, which is quite frequent, is one of the chief drawbacks to the use of this measure. He also reminds us that considerable pain is usually present during the first 24 hours and may persist for several days. The only justifiable indication for ligation without excision is presented by the case in which the general condition of the patient is precarious. Even in such circumstances there is much reason to question the use of this measure, since the shock occasioned by the pain which is bound to follow may well offset the benefits of the shortened operation. Effective narcosis is often difficult to obtain with safety in some cases, especially when the duration of suffering is at all protracted. Hirschman (6) recommends this measure in desperate cases. He cuts the circulation to the mass by ligating the upper half of the tumor base with the aid of a ligature carrier. This procedure is not, however, one of choice, and the undesirable features associated therewith should be carefully weighed before it is utilized.

Bodkin (5b) describes a method devised by Rickett, known as "submucous ligation," in which the mass is encircled by a ligature carried around its base beneath the mucosa. The originator claims that secondary hemorrhage is impossible with this measure, that no tissue is unnecessarily sacrificed, that no areas of ulceration occur, that very little pain is caused, that no stricture results, that no infection is invited, and that very little time is lost by confinement to bed. Uncomplicated atrophic changes occur in favorable cases, but the tumor is apt to become markedly engorged, and multiple punctures may be needed to liberate the blood. The measure can not be properly employed in connection with masses that are closely opposed, and it is obvious that such treatment is unsuited to the more extensive lesions. Notwithstanding the contention of Rickett to the contrary, it is also evident, as Bodkin points out, that infection with subsequent abscess formation is invited by this measure.

The ecraseur and the angiotribe, which are essentially the same, and which depend upon crushing action alone for hemostasis, are



no longer popular. The objections to these instruments are sufficiently obvious to need no elaboration.

Pennington (7a) describes a special clamp devised by Barnes which grasps without crushing force, as do those used in intestinal work. The instrument is applied to the base of the hemorrhoid, the mass is excised, and the blades are allowed to remain in place for 10 minutes or more. The handles are detachable and are removed during this interval in order that the blades may not become dislodged while hemostasis is awaited. No ligation, suturing, or cauterization is performed. It is claimed that a minimum of tissue injury is occasioned and that the dangers of infection and secondary hemorrhage are lessened. It is difficult, however, to understand how assurance against either delayed or secondary bleeding is afforded by such a measure.

The clamp and cautery method, ligation with excision, and the Whitehead operation are the only surgical procedures that have obtained widespread popularity. But ligation with excision, unlike the other two mentioned, is performed in a multitude of various ways. The operations which may be grouped under this heading constitute, in fact, the bulk of those devised for hemorrhoids removal. In this group may be found that which is best as well as that which is least desirable for the treatment of this disease.

#### THE CLAMP AND CAUTERY

Cusack, of Dublin, who is credited with originating the clamp and cautery operation, used strong nitric acid to seal the wound. Following the introduction of the actual cautery as a part of this procedure by Lee and Smith in England, the method gained enormous popularity, which has persisted with little abatement almost to the present day. The procedure is still widely used and continues to command a prominent place in the majority of modern textbook descriptions. Da Costa (8a) recommends it as the method of choice for ordinary cases. Montague (9a) describes it as one of the most approved of modern surgical procedures for the removal of hemorrhoids. He states, however, that while the measure is extensively used by the general surgeon it is considered *passé* by the proctologist, except in special cases (9b). He believes that when properly performed, the method may be used in any type of internal hemorrhoids with an assurance of good results, but considers it especially applicable to the ulcerated, thrombosed, and gangrenous masses (9c). While a reaction against this method has been apparent in general work for some time, the place that it has occupied in the past and the place that it still occupies today, whether justified or not, entitles it to front rank among the classics in the therapy of this disease. All authorities,

however, agree that hemorrhage is liable to follow its use. Da Costa (8a) directs attention to the necessity for ligating bleeding points following removal as a precaution against subsequent hemorrhage. Montague (9d) admits that accurate hemostasis is impossible with this measure and refers to the fact that control of hemorrhage after operation may be a very difficult matter. It is easy to understand the popularity of this method in the past. It afforded a simple and rapid removal and permitted results equal or superior to many of the procedures then in use. This is, however, no longer true. A number of present-day ligature operations assure uniform success for average hands in ordinary cases. If they lack something of the simplicity of the clamp and cautery there is ample compensation in the additional safety afforded. It does not seem that either the ease or rapidity with which a hemorrhoidal tumor may be removed by the clamp and cautery justifies the adoption of a procedure that is liable to be followed by troublesome or dangerous bleeding.

#### THE RELATIVE VALUE OF THE METHOD

The relative merits of the various operative procedures can not be indicated by any classification founded solely upon a consideration of the nature of the measures themselves. A knowledge of the various techniques is essential, of course; yet a determination of the desirability of any given procedure will depend upon an understanding of the circumstances under which it may be best used as well as a familiarity with its technical advantages. We can not easily determine the operations of choice until we first understand the indications to be met. If any attempt is to be made toward a relative evaluation of the therapeutic importance of hemorrhoids operations it might be advisable to classify indications rather than operations, and then select those measures best suited to the various types of requirements enumerated. It is not as easy to speak of desirable operations and undesirable operations in this connection as it is in many surgical considerations. But in general practice this is frequently attempted. There are many measures which are unalterably undesirable under any circumstances, it is true. There are a few which possess a range of adaptability that renders them useful in a majority of the indications to be met. But these are very few. There is none which adequately meets all indications. No method can be classed as desirable under all circumstances. A great majority require some forethought with respect to the circumstances which assure the greatest possibilities for their successful utilization and admit of the fewest opportunities for harm.

Binnie (10a) states that "each surgeon knows that the method he uses gives better results than any other." Such an observation is

probably significant of the attitude assumed by many general surgeons in this connection. Such opinions are, however, not only pardonable under some circumstances, but are justifiable expectations on the part of the patients. The physician should certainly possess a justifiable confidence in the merits of his procedures; yet, as before mentioned, it is important that all surgeons be chary of becoming too deeply impressed with the possibilities in one method to the exclusion of others. Pennington (7b) cautions moderation in one's attitude toward any procedure, in the following quotation:

It is amusing to observe how various surgeons extol the virtues of their favorite method of operating. The facts are bad results may follow any and all methods. What the surgeon should seek to know is the method having the fewest objections, and the greatest number of worthy points. I have seen contractures and strictures follow all operations.

#### INDICATIONS FOR OPERATION

Montague (9e) states that nonoperative treatment of internal hemorrhoids is justified only in those cases which are giving rise to no symptoms. He believes that operative measures are demanded in all instances of complicated hemorrhoids and in the presence of complicating anorectal diseases. Inflammation, prolapse of the hemorrhoids, ulcerations, and strangulation are given as the chief complications, while anal fissure, anal fistula, and cryptitis are mentioned as complicating anorectal diseases. He feels that there are now few contraindications to hemorrhoidectomy, but mentions the fact that radical removal should be deferred when ischioanal abscess and other acute infective anorectal conditions are present. He states that when carcinoma is present the hemorrhoids must, of course, be disregarded in favor of the more serious condition. He further refers to the fact that when hemorrhage has been sufficiently marked to reduce the hemoglobin to a dangerous level the operation must await transfusion or general tonic measures.

#### OPERATIONS IN SIMPLE CASES

Simple ligation with excision is a satisfactory method of removal for the small pedunculated and other minor tumors. Ligation with transfixion, with or without preliminary circumcision of the tumor base, followed by excision, is an approved method for moderate sized hemorrhoids. The Mathews operation in which transfixion with double ligation is performed has enjoyed considerable well-merited popularity among procedures of this type. Many operators recommend circumcision of only the distal half of the circumference of the mass, since the abundant blood supply to the upper portion of the tumor renders hemorrhage more likely to accompany any incision

in this area. The clamp is frequently used in connection with minor removals, but there are no special indications for its employment under such circumstances.

#### THE MORE EXTENSIVE LESIONS

The more extensive hemorrhoidal masses are composed of a network of dilated vessels, and are, in a stricter sense, vascular tumors rather than simple varicosities. An hemorrhoid is not, however, in any sense, a neoplasm. Usually three well-defined masses are present, but occasionally as many as five or even seven tumors may occur. Growth, or better, the progress of involvement, is ordinarily slow and the patient comes to operation with a history of a more or less protracted period of discomfort. Bleeding usually occurs sooner or later as a result of some form of irritation. Abrasions, fissures, and ulcerations are common. Inflammation is present from time to time in varying degree. Prolapse of the masses is a frequent occurrence and some degree of actual prolapse of the rectal mucosa is commonly associated with the larger and more chronic lesions. Clamp and suture methods have been extensively employed in the removal of these tumors and a majority of the older hemorrhoids operations are based upon suture closures. The measures devised for such purposes have been numerous and often ingenious, but most of them have fallen short of expectations because of the insecure principles upon which they depended.

#### OPERATIVE REQUIREMENTS AND THE OLDER METHODS

Warbasse (11) summarizes the desiderata for an hemorrhoids operation essentially as follows:

1. That it should cure the disease.
2. That it should be expeditious of execution.
3. That it should sacrifice a minimum of blood.
4. That it should be free from the danger of post operative hemorrhage.
5. That it should leave no stenosing scar.
6. That it should invite the least infection.
7. That it should be capable of performance under local anesthesia.
8. That it should cause a minimum of pain.

No operative procedures can easily ignore these stipulations with any well-founded expectations of uniform success. The permanence of cure depends to some extent upon the age of the patient as well as the thoroughness with which the tumor is removed. Recurrence is less frequent as age advances. Pennington (7c) quotes Miles as saying that a recurrence of the condition within 10 to 15 years is common in those under 30. After 40 the cure is permanent if the removal is properly performed.

Not all of the operations now in use are as expeditious of execution as might be desired, and some consideration of this factor is of value when a selection of methods is made for cases in which shock minimization is important. Assurance against blood loss is not adequately afforded by many of the older and some of the more modern procedures. Here again a choice of operation requires some discrimination if this factor is to be reduced to a minimum. Many of the older methods likewise give insufficient security against post-operative bleeding, but this accident has been largely eliminated in the newer procedures. Reports similar to that of Smith (12), who has performed a series of corrective operations for anal deformities, indicate that stenosing scars, or at least those resulting in partial stenosis, are still too frequent in general practice. No data upon the relative frequency of abscesses following hemorrhoidectomy in general work are available. It is, however, significant to note that a majority of the newer measures were designed with the prevention of this complication as a foremost consideration. No difficulty should be encountered in the abolition of pain during operation, but some question may arise as to the most desirable method of anesthesia in a given case.

Mitchell's operation still enjoys a measure of popularity in general practice despite its very evident deficiencies. In this procedure the mass is clamped at its base and excised. A continuous suture, encircling the clamp blades, is then placed, and as the latter are loosened and withdrawn the suture is pulled taut and secured. This operation does not afford good hemostasis. The suture can not maintain a proper tension in a relaxed tissue such as the rectal mucosa without fixed counter tension upon the suture ends or unless the wound edges are completely pursed before the final stitch is secured. The latter measure should never be employed for obvious reasons. Marked puckering of the wound edges prevents adequate approximation. Healing is therefore insufficiently advanced when the suture breaks. (All absorbable suturing material, even of the hardened variety, becomes quickly softened in the moist rectal tissues and gives way in several days.) Disruption of the wound is likely to follow and the course of healing is then unusually protracted. In the absence of complete pursing, the suture often fails to adequately control even the immediate hemorrhage. Delayed oozing is common in either case. The operation, in addition, invites infection, which is alone sufficient to debar it from favor.

Of the numerous other suture methods described, that of Thomas only will be mentioned. Binnie gives his preference to this procedure and the measure might be considered to represent the best in this class of operations. The tumor is excised over a clamp and the mucous membrane brought together by a cobbler's stitch, using

two sutures on separate needles. Pursing action is largely eliminated and control of hemorrhage is quite efficient. The removal is not, however, as complete as is desirable, due to the necessity for allowing a cuff of membrane to remain above the clamp blades for a suture bed. But more important than anything else, this procedure, like that of Mitchell, invites abscess formation. This alone is sufficient to condemn the operation, and, with it, all suture methods.

#### MODERN PRINCIPLES AND THE NEWER OPERATIONS

The present trend of opinion with respect to the surgical treatment of hemorrhoids may be indicated to some extent by the following summary.

(a) Operations which sacrifice the least in normal tissue (notably mucous membrane) are held in highest esteem by increasing numbers of operators. This is in keeping with surgical practice in general, where an increased regard is now exhibited for physiological considerations.

(b) Extensive dissections are no longer regarded with general favor, since the persistence of any sizable area of damaged tissue is manifestly undesirable. Minor dissections are, however, still performed in a number of the newer operations for removing a portion of the varicosity or for freeing the tumor base to permit an effective ligation of the blood supply.

(c) Experience has so forcibly demonstrated the frequency of infection in hemorrhoidal wounds that the "closed" methods are no longer considered acceptable for use. The disfavor with which such procedures are regarded must eventually eliminate a large proportion of the operations devised for the removal of hemorrhoidal tumors. It is the persistence of such measures in general practice which has occasioned much of the critical concern among proctologists. The wounds which are complicated by abscess and fistula formation are almost invariably those in which suturing was attempted. An hemorrhoids operation is performed in an infected field and contamination of the wound must be expected. Adequate drainage is therefore required and most operators feel that this can best be effected by leaving the wound open. The operations of Hirschman, Montague, Martin, and others definitely reflect this principle. Pennington advocated such a measure over 20 years ago. His work in this direction apparently antedates all others, and the Pennington operation may be accepted as the basis for this now popular procedure.

(d) The clamp is not so freely used as heretofore. Hirschman (13), who is among those condemning its use, points out that its bite frequently does not include all the diseased mass. When it is deep

enough to do so the sphincter is liable to injury. In addition to this, the crushing action of the clamp leaves an area of devitalized membrane which is prone to bleed.

(e) Operative, together with postoperative bleeding, are now frequently controlled by a preliminary ligation of the chief vessels of supply to the area involved. Hirschman claims that three ligatures, when properly placed, may be made to control the circulation of the entire anal circumference.

(f) Divulsion of the sphincter is now widely condemned. The temporary paralysis so produced may cause much pain and discomfort following operation, while rupture of the muscle may result from undue tension. The procedure is not only undesirable but unnecessary since several of the various methods of anæsthesia afford ample relaxation.

(g) The padded rectal tube appears to have gained nothing in popularity, although it is still used with apparent frequency in general practice. A majority of operators contend that it serves no useful purpose if the operation is properly performed and is the occasion for considerable discomfort to the patient. Binnie's (10b) suggestion that "this dressing ought to be reserved for personal enemies and malefactors" appears to voice the sentiments of many. Specially devised nonpadded and self-retaining rubber tubes are, however, extensively used to assist in the expulsion of gas. Some also advocate their use for the purpose of detecting bleeding. But occasions necessitating such precautionary measures should now be few. Small gauze tampons or rubber dam drains are used in connection with a number of the open methods of operating. Packing has, of course, been long abandoned.

(h) General anæsthesia is now rarely necessary and has been discarded by many except in the presence of special indications.

The operations of Pennington, Martin, Montague, and Hirschman represent much that is best in modern proctologic practice. Excellent results are being obtained with these and similar measures, yet none of them appears to be well suited to the removal of extensive masses. It would also seem that several of the features in these measures render them objectionable for use by the occasional surgeon in special circumstances.

Pennington (7d) (14) everts the mass by the use of specially devised triangular bladed forceps applied close to the mucocutaneous juncture, and converts the operation into an entirely external procedure. An elliptical section is removed from the top of the tumor with curved scissors (the size of the section depending upon the extent of the mass) and the pile bearing area is then dissected out. "Bleeders" are grasped with hemostatic forceps and ligated. Each

tumor is successively treated in like manner and the wounds are left open. The operation is not well suited for extensive removal—certainly not in average hands. It would also appear to be undesirable for use in those cases in which operative blood loss is feared. Bleeding, while on the table, is apt to be rather free.

Martin (15) operates by what he calls a "composite technique." He places a ligature above the tumor so that the vessels which enter and leave from the superior aspect of the mass are controlled. He then completely excises the tumor and allows the wound to remain open. The occasional surgeon may experience some difficulty in obtaining effective hemostasis with this measure. Some oozing from the inferior circulation will occasionally be encountered and subsequent ligations will, not infrequently, be needed.

Montague (9f) makes a preliminary incision in the mucous membrane on the outer (inferior) aspect of the tumor base. The incision is carried upward on either side of the mass for one-half inch. The tumor is then gently dissected away from the submucosa with the scissors' blades or with the gauze-covered finger. The dependent mass is then transfixed and ligated at its base. The tumor is now excised and the wound left open. A round needle is used and the ligation is a double one. Mummery crushes the stump before placing the ligature as an assurance against slipping. Some operators partially or completely close the wound. This measure is not well adapted to the removal of large masses, since only a reasonable amount of tissue can be included in even a double ligation. Some oozing is liable to occur in the area not included in the ligation. Suture closure of the wound is, of course, to be condemned.

Hirschman controls the circulation to the hemorrhoid by ligating its upper half at the base with the aid of a ligature carrier. In his earlier operation an incision is then made over the body of the hemorrhoid and the pile-bearing area dissected out en masse with the aid of forceps and scissors. Care is observed not to encroach too closely upon the ligature. Pennington, or other suitable forceps, are used to expose the field. The wound is left open to heal by granulation. Hirschman (13) has recently modified the original technique by performing an excision of the redundant portion of the mass in place of the incision formerly employed. The pile-bearing area below the normal mucous membrane is then dissected out as before. One long end of the preliminary ligature may be used to place a single suture in the wound. It may also be used to place a second ligature to control any oozing that may arise from the inferior circulation. This method, like that of Montague, is not well suited to the removal of extensive masses. It also affords the same possibilities for troublesome post-operative oozing.



The four measures above described may be accepted as representative of the best in modern operative procedures. Dangerous infections, strictures, and most other complications are eliminated by their employment. The routine use of the Pennington method is not, however, to be recommended, because of the imperfect blood control during operation. The occasional surgeon may also encounter some difficulties in obtaining satisfactory hemostasis by the Martin technique, in connection with the more extensive lesions. The operations of Montague and Hirschman appear to be both safe and satisfactory for use in average hands for removing small and moderately large tumors. They would seem, in fact, to be as nearly ideal as any of the measures now in use for the types of lesion mentioned. Their scope, in the hands of the average operator at least, should, however, be restricted to ordinary cases.

#### THE SERIOUS CASE

One is not infrequently confronted by a more serious condition than that apparently contemplated by the measures usually described, and the question as to the most expedient procedure may at times present a problem of moment. The gut may be completely encircled by a more or less irregular, but continuous, hemorrhoidal mass, which when prolapsed attains to sizeable proportions. Some degree of actual prolapse of the rectal mucosa is frequently present. Abrasions, ulcerations, and fissures are common. Many of these lesions are of long standing, and the general condition of the patient may be decidedly unfavorable for immediate radical treatment. Marked anemia is frequently present and serious constitutional disease may coexist. Hemophilia, pregnancy, etc., may complicate the picture. The situation may at times be desperate.

Early and radical removal is always indicated in such cases and one's judgment is often well tested in deciding between immediate operation and a preliminary attempt to improve the constitutional condition. Hirschman and Rosenblatt (16) have demonstrated that such masses may even be carcinomatous in nature without any readily recognizable clinical evidence of this fact. It is not improbable that an appreciable number of rectal malignancies have such a condition as an unsuspected origin.

From the standpoint of treatment it will be found convenient to consider the serious case as belonging to two distinct categories, depending upon the type of lesion encountered. The first group includes those cases presenting a varying number of discrete tumors, while in the second, one irregular but more or less unbroken mass encircles the anal circumference. Those cases belonging to the first group are not necessarily classed as serious because of technical

difficulties associated with their removal. The factors which most frequently occasion concern are the unfavorable general condition of the patient, and, less commonly, the presence of local complications and coexisting anorectal disease. But in many instances the available measures do not adequately answer all the requirements connected with the mechanics of the removal itself, and the operator may be confronted by a technical as well as a clinical problem. A case in point recently appeared on the writer's service with a markedly reduced hemoglobin percentage and a red cell count of 1,200,000. Minor hemorrhages had occurred at irregular intervals over a period of months. These became more frequent and more profuse, however, during the fortnight prior to admission, and the patient reached the hospital in a condition decidedly unfavorable for any operative procedure that admitted of further blood loss, however small. A preliminary ligation of the relatively numerous bleeding points appeared to call for measures little less shock provoking than a radical operation itself. Hirschman's practice of ligating without excising in desperate cases was not considered practical or desirable, due to the extensive nature of the involvement as well as a conviction that the swelling and pain following such a procedure cause as much shock as many of the radical operations themselves. The method of choice in such a case was considered to be one combining rapidity and simplicity of execution with ability to effect a complete and bloodless removal. A special technique was devised with the above factors in mind, and, although we were fortunately able to bring the patient to a more satisfactory state prior to operation, the use of the above-mentioned procedure in this and subsequent instances demonstrated the possibility of obtaining satisfactory removals in advanced cases by bloodless means and with a method applicable to the routine use of the occasional surgeon. This technique, as subsequently modified, is described below.

#### A BLOODLESS OPERATION

In those cases in which blood conservation is vital, the general condition of the patient is usually such that no factor of management can be slurred. Such considerations as preparation, anesthesia, and aftercare demand the closest attention. No hard and fast rules can be applied in this connection, but the routine of management that has proved most generally satisfactory in the writer's hands will be briefly outlined below.

The patient is prepared in the usual manner, with a restricted diet the day preceding, a saline cathartic the morning before, and an enema the evening prior to operation. The rectum is thoroughly irrigated an half hour or so before operation and several ounces of

a 5 per cent solution of mercurochrome are injected into the bowel at the time of preparation on the table. Sacral anesthesia is used. Divulsion of the sphincter is unnecessary and should not be attempted.

The mass is prolapsed with the fingers and placed on the stretch by two hemostatic forceps which grasp the tumor pinnacle near its superior and inferior extremities. Adequate prolapse converts the operation into an entirely external procedure.

The tumor base is now lightly grasped by a slender clamp, the blades of which are parallel to the long axis of the bowel. The depth of application must be sufficient to underlie the entire mass, but it must not be sufficiently deep to include any portion of the external sphincter. This may be avoided by rolling the stretched tumor base between the fingers to assure that the muscle is absent

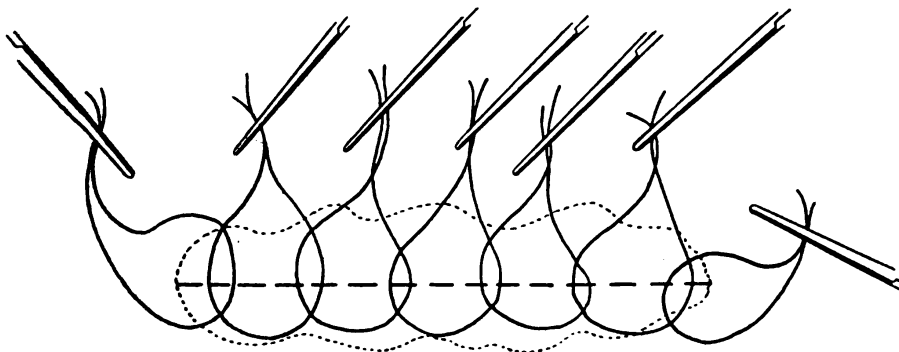


FIGURE 1

in the line of clamp application. The instrument is applied with a pressure only sufficient to keep the tumor in satisfactory position during operation and to act as a guide for the sutures about to be placed. This method of application is intended to eliminate any crushing injury to the mucous membrane. A special instrument resembling a small intestinal clamp is preferable to the ordinary type, but not essential. The mass is elevated by the hemostatic forceps held in the hands of an assistant, or these may be removed and the tumor manipulated by the clamp alone. The former plan will be found to give a better field in which to work when the mass is large.

An interlocking chain suture is now introduced beneath the clamp with the use of a Reverdin needle. (Fig. 1.) Beginning at one end of the mass, the needle is passed beneath the clamp, threaded with No. 2 chromic catgut by an assistant, pulled through and reintroduced about a half inch away from the original puncture. The suture is then released and the needle withdrawn. The free ends of the suture are grasped by hemostatic forceps, which remain in place

until removed for tying. The needle is then introduced between the two points of insertion just mentioned, about one-eighth of an inch away from the second puncture. It is then threaded, pulled through, and reintroduced about one-half inch from the third puncture. The catgut is released as before. Each suture is introduced in like manner until the series is complete. The needle must be introduced in such a manner that the sutures will interlock. This may be easily effected by leaving the looped end of the preceding suture long, until the succeeding suture is introduced. The needle is carried through the loop from above, to emerge below the contiguous free end. The method of introduction is illustrated in Figure 2. It is to be noted that in the case of each end suture the tumor base is punctured but once, as indicated in Figure 1. The clamp blades serve as a guide for the needle point, which is introduced flush against their under sides. All punctures are, therefore, in the same plane, and each is overlapped by a suture when tying is completed. A dull needle point is used to prevent injury to blood vessels. The point of an ordinary Reverdin needle may be properly blunted by filing. When the danger of hemorrhage is not feared the intervals between the needle punctures may be somewhat greater than one-half or one-eighth inch, respectively.

The end sutures are now tied, following which the alternate units in the series are secured. (Second, fourth, sixth, or third, fifth, seventh, etc., as preferred.) The tying tension should be snug but insufficient to cause appreciable constriction of the tissues within the suture grasps. The clamp is now removed and the remaining sutures are secured. The tying tension should now be sufficient to take up all slack in the suture line and assure a moderate constriction of the included tissues as well. Undue tension is unnecessary and undesirable. The clamp is then reapplied as before and the tumor excised above its blades, the latter serving as a guide for the knife edge. If the clamp blades are sufficiently slender, the procedure is complete; if not, the remaining cuff of mucous membrane should be trimmed to a desirable width. Each tumor is successively treated as above described.

Several ounces of mercurochrome are again introduced into the rectum and a small caliber, self-retaining rubber tube is inserted for the purpose of aiding gas expulsion. Many object to the use of even a small tube, and this matter should be left to the preference of the operator. The tube should be removed in 12 hours. The bowels may be moved by enema on the third day if circumstances make this advisable. Mineral oil may be given daily from then on, as long as confinement to bed continues.

It is believed that the measure just described is more nearly bloodless than any offering the same security against delayed and

secondary hemorrhage. It is possible that some oozing may occur from needle punctures when blood vessels are injured between the time of suture introduction and tying. But this is not a troublesome matter when the needle is properly dulled. After tying the control is as absolute and permanent as any ligation with absorbable material in this location can be. Bleeding following the softening and breaking of the sutures is rare when healing has progressed satisfactorily prior to this event, as it will in a wound that is freely drained and in which approximation is adequate. Infection of a troublesome nature is not invited, since the measure is, in effect, an open one. No area of damaged tissue remains as is the case when dissection is performed, and no crushed and devitalized mucous membrane persists, because of the method of clamp application. The measure is simple in execution and safe in average hands. It requires no special experience and is as rapid as any offering the same degree of security. The most extensive discrete masses may be easily, thoroughly, and safely removed—something that can not be said of many of the measures now in use.

#### MODERN OPERATIVE STANDARDS

The above procedure is believed to be in satisfactory conformance with the previously mentioned stipulations of Warbasse. This indicates that there is reason to expect that it will adequately fulfill the requirements of the general and occasional surgeon with respect to the desiderata for operation. Since, however, the proctologist is largely responsible for a majority of the recent advances in this field, no measure should be accepted for trial without some attempt at an evaluation of its possibilities by proctologic standards. Hirschman (17) has stated that the following considerations have much to do with the success of any operative method:

1. Safety.
2. Removal of all diseased tissue.
3. Preservation or restoration of function.
4. Minimum traumatization.
5. Prevention of hemorrhage.
6. Preservation of sphincteric continence.
7. Insurance against recurrence.
8. Freedom from infection.
9. Prevention of pain during and following operation.
10. Minimum hospital confinement and detention from ordinary occupation.

He recommends the use of a ligature before excision as a standard procedure, and states that inasmuch as most patients are more or less anemic, blood conservation should be practiced whenever possible. He emphasizes the fact that tying before cutting not only conserves the patient's blood but presents a much cleaner field for operation.

He reminds that suture closure may imprison infectious material in the wound and lead to disastrous results.

An observation of Watson's (18) is of interest with regard to detention from occupation. He expresses the opinion that 10 to 12 days in bed are perhaps more economical in time and money than any ambulant method which requires a more or less protracted period of management. This would seem to be a rational stand wherever economic considerations do not place an undue premium on confinement. In ordinary circumstances the general or occasional surgeon is serving the best interests of his patient by instituting a radical

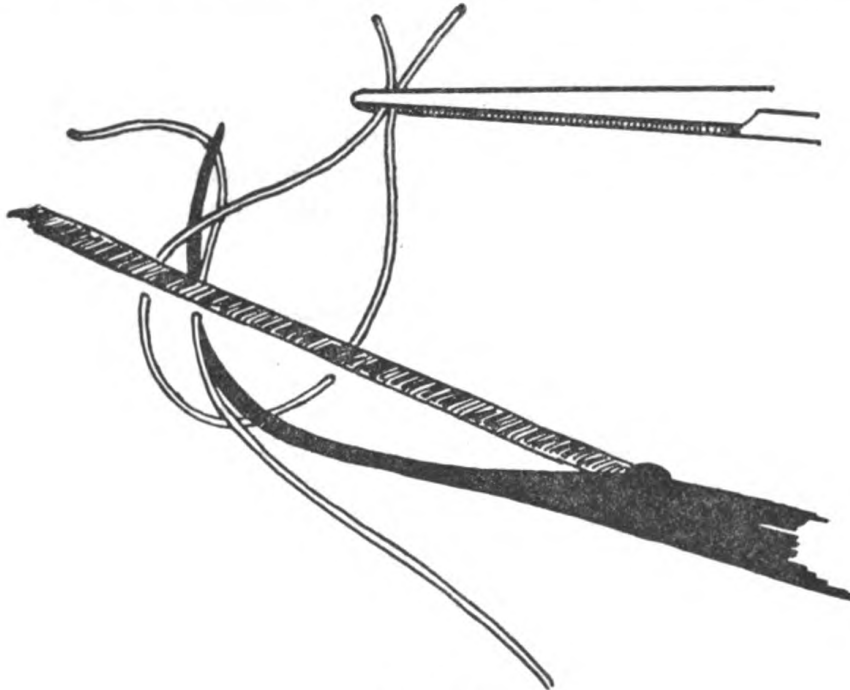


FIGURE 2

procedure. The operation which effects a rapid, safe, and permanent cure is considered to be most desirable in average hands. In the more extensive lesions such a procedure is almost imperative.

#### THE "3-NEEDLE METHOD"

Pennington (7e) describes a measure devised by Reader, known as the "3-needle method," in which the ligation is somewhat similar in principle to that described above. The tumor is grasped by a clamp in the ordinary manner. Three curved needles are threaded on a single ligature and passed beneath the clamp blades at equidistant points, as illustrated in Figure 3. The loops carrying the needles are then cut and the latter removed, whereupon the four units thus formed are secured. Interlocking was not performed in the original

procedure but may be easily effected by merely twisting contiguous suture ends. Oozing, in the event of blood-vessel injury, can not, however, be properly controlled, since the punctured vessels are not adequately compressed, even when the sutures are interlocked. Three needles are, of course, too few for extensive removals; yet more may prove rather cumbersome to manipulate under some circumstances. The use of crushing clamp force is objectionable, and silk sutures, which were used in the original method, are not now approved in rectal work.

#### THE BOOKMAN SUTURE

Bookman (19) devised a very rapid and ingenious method of suture introduction, intended for use in abdominal surgery. This

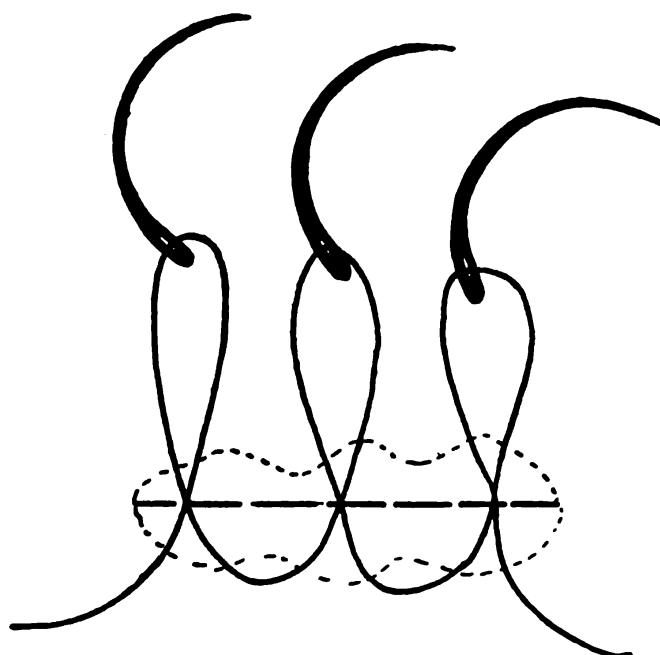


FIGURE 3

measure is easily adaptable to hemorrhoid work and should at times prove very effective in this connection. One long suture, fed from a spool, is introduced in successive loops with a self-threading needle in a manner similar to the method of Reader. The loops on one side of the wound are then cut and the units secured after twisting contiguous ends so that interlocking occurs. There is also some possibility of troublesome oozing with this method when blood vessels are punctured, as is the case with the "3-needle" operation.

#### VENOUS TRANSFIXION

A reference to the harmful possibilities attending blood-vessel injury in the anorectal area is very infrequently encountered in the

literature. Secor (20) quotes the late J. B. Murphy as saying that the "transfixion of a vein with a suture in a zone grossly subjected to infection as the anus should not be done. The day of disaster is sure to come. An ascending infection through the middle and superior hemorrhoidal veins into the inferior mesenteric produces the fatal pylephlebitis." But reports of disastrous terminations chargeable to this factor are rare.

Direct ligation is the most surgically correct method of hemostasis without doubt. But the Whitehead operation would qualify as one of the most approved procedures if such a criterion were to prevail alone in this connection. No procedure capable of such mischief can be considered correct. On the other hand, practically all of the present-day operations are open to the possibilities of blood-vessel injury, and can not therefore avoid such criticism as may be advanced through this circumstance. Secor (20) describes a method in which a cobbler's stitch is introduced through the fenestra of a specially devised clamp. But it is difficult to understand how this measure avoids the possibility here referred to more than do most of the other procedures. Present-day experience does not seem to place so sinister an admonition upon procedures admitting of blood-vessel injury as did Murphy. But every precaution should nevertheless be observed to avoid the unnecessary transfixion of blood vessels.

Mercurochrome in aqueous solution was adopted by the writer for routine use in connection with hemorrhoids operations as a result of the favorable reports attending its application in the vagina in connection with certain operative obstetrical procedures. The investigations of Rodriguez (21) Reddish and Drake (22), and Scott, Hill, and Ellis (23) should tend to curb any undue optimism as to the probable germicidal efficacy of aqueous solutions of this agent upon the unbroken skin and mucous membrane. But there is nothing as yet in evidence to disturb the confidence which experience would seem to justify as to the value of aqueous mercurochrome in the open wound. Kraker (24) reports that the routine use of this agent following hemorrhoidectomy prevents infection, aids granulation, and shortens convalescence to a considerable degree. Few objections can be raised against the use of mercurochrome in this connection, and there is much to indicate its superiority over other available agents for this purpose.

#### ANESTHESIA

Anesthetic effectiveness should no longer control the selection of agent or method of administration. The possibilities for inducing effective anesthesia outnumber the probabilities of safety, and modern practice not only permits but should demand the utmost consideration for the latter factor. Caution against overgeneralization



in this connection must still be exercised, since that which constitutes safety in some hands may not do so in others. Yet the status of rectal anesthesia already permits of several fairly broad standardizations of procedure, even though a generalized accord of opinion has not been established.

The rule may be set down that general anesthesia should be avoided whenever possible. The abandonment of respiration anesthesia has accomplished as much as any one thing toward removing hemorrhoids operations from the fold of unsafe procedures. Montague (9g) states that "when properly performed, hemorrhoidectomy is one of the safest of all operative procedures and the operative risk involved approximates nihil. This is because of the possibility of avoiding, when required, the use of general anesthesia by the substitution of either sacral anesthesia or local anesthesia." Hirschman (6) feels that one must be extremely careful in the selection of cases for local anesthesia. Although he has never seen a case that he could not successfully operate upon with the aid of this measure, he believes that the sacral method is the best for the occasional surgeon when a great deal of rectal prolapse is present. He thinks that hemorrhoids complicated by fistula, extensive ulceration, complete rectal prolapse, or abscess are best treated by other than local methods, and that "there is a limit beyond which it is possible to go, but not wise" in connection with all extensive involvements.

Some object to local anesthesia because of the possible distortion of the operative field. But this need not, and in fact should never, occur. Attempts at nerve blocking are unsuccessful in the rectal area due to the complicity of the innervation, and infiltration methods must be used. Hill (25a) describes a simple technique by which the entire anal circumference, together with both sphincter muscles, may be infiltrated with the use of but two surface punctures. Insertions are made both anterior and posterior to the anus and the tissues are injected for a depth of nearly 2 inches by partial withdrawals and reinsertions of the needle through the original surface punctures.

Murietta (26) defends spinal anesthesia by stating that reported fatalities are almost invariably due to the use of the method in hypotensives, or, rarely, to an overdose of the agent injected. He thinks that spinal anesthesia is safer and saner than general and easier to give than sacral. He states that the element of failure in sacral anesthesia, which he gives as between 10 and 20 per cent, is reduced to nil by the spinal method. Hirschman (27) contends that the failures in sacral anesthesia are due to an insufficient amount of the injected novocaine. He thinks that anything that can be done with spinal can be accomplished with the sacral method. But he sees

no necessity for transsacral injections and cautions against their use because of the danger of injuring the bowel in the attempt. Buie and McCuskey (28) report only four failures out of 213 hemorrhoidectomies in which sacral combined with transsacral anesthesia was employed at the Mayo clinic. They summarize the advantages of the method as follows: No distention of the perianal tissues; complete relaxation of the anal muscles; freedom from catheterization during the postoperative period; absence of risk; complete anesthesia, almost without exception; and slight delayed anesthesia that reduces the postoperative pain to a minimum. Linthicum (29) does not think there are many who know the anatomy sufficiently well to do sacral anesthesia. He states that it is not always easy to go in just at the juncture of the sacrum and coccyx and that men who are doing this sort of thing have difficulty in getting in.

There can be no question with anyone who has used sacral anesthesia that the measure marks a distinct advance in rectal surgery. It is safer than local infiltration in relatively inexperienced hands and is easy of performance in the vast majority of cases. If anesthesia fails, and it will rarely do so if a sufficient quantity of novocaine is employed, nothing is lost. Local or general anesthesia may still be used. If the precaution is observed to watch for a flow of spinal fluid after placing the needle and before injection is made, the spinal canal is not implicated. The same degree of safety is impossible to any other method, and for this reason alone it is the approved procedure for the occasional surgeon. Transsacral injections should, however, be omitted.

Spinal anesthesia should be dismissed as a method of choice for the occasional surgeon. It is the easiest of all measures, no doubt, but it is a questionable procedure in this connection under any circumstances. There are many occasions in which the spinal canal should be entered, but I do not believe this is one of them.

#### THE ENCIRCLING MASS

The Whitehead operation was, until recently, the universally approved form of treatment for those lesions falling into the second group of the previously suggested division of serious cases. The proctologist and general surgeon alike now, however, condemn this measure almost without exception. Smith (12) quotes Mummery as saying that if the London meeting of the American Proctologic Society in 1924 had accomplished nothing else it would have justified itself by having sounded the death knell of the Whitehead operation. The procedure depends for success upon primary union, and as Da Costa (8b) points out, this is rarely secured. The same authority (*ibid.*) quotes Andrews in enumerating other and serious

consequences that may follow its use. Stricture is not infrequent, fecal incontinence may occur, anal anesthesia with involuntary passage of gas is a common sequence, and the anus is at times more or less uncomfortably moist as an aftermath.

Hemorrhoids surgery has been immensely benefited by a more general realization of the reasons for the failure of the Whitehead procedure. But somewhat paradoxically this increase in knowledge has served to confuse rather than clarify the selection of methods for the type of case under consideration. Much has been written regarding the now evident deficiencies of the Whitehead and other procedures utilized in this connection, but the literature has been, unfortunately, even if necessarily, silent in the matter of satisfactory substitute measures. This may explain the continued, although greatly restricted, use of the Whitehead operation in general work. It may also have some bearing on the very exceptional and rather inexplicable opinions similar to those of Carless and Wakeley (30) still to be observed. The aforementioned state that "this operation (the Whitehead) is most successful and satisfactory, and is the only one that should be adopted in bad cases." They admit that "occasionally infection of the wound occurs and the stitches give way, leading to the exposure of a circular raw surface, which in time heals by granulation, but is followed by contraction, and this, unless kept dilated, may result in stricture." Hill (25b) is almost alone among proctologists in adopting a tolerant attitude toward the Whitehead operation. In speaking of the clamp and cautery, the ligature, and the Whitehead methods, he states that any of these, if intelligently utilized, will prove universally satisfactory. He goes on to remark that in certain varicose conditions associated with a general prolapse of the mucosa the Whitehead operation is more effective than either the clamp and cautery or the ligature methods. He, however, personally prefers to remove such a mass with the "three-needle" method.

Gant (31) condemns the circular excisions of Whitehead and Pratt (the latter is essentially a modification of the former). He sees no reason for removing the entire circular area when not all of the membrane is involved and describes a measure as a substitute for the two in which the entire mucous circumference is not excised. He removes the pile-bearing areas with the assistance of linear excisions and inserts wick drains into the wounds before closing the same. Since, however, the Whitehead operation is considered in the present discussion only in relation to the unbroken, encircling mass, Gant's method, inasmuch as it does not effect a complete removal, can not be considered as a substitute for the Whitehead procedure for present purposes. Although Gant objects to the lack of drainage

in the Whitehead operation, his wick method is not considered to properly eliminate the possibility of infection.

Bell (32) describes a measure by which a complete removal of a moderately large encircling mass may be easily effected. He passes three silk ligatures through the mucous covering of the tumor or tumors, one anteriorly and one on either side. The pile-bearing area is prolapsed and placed on the stretch by pulling upon the ligatures so that the operative field is converted into a triangular-shaped mass. The base of each of the three sections thus formed is successively caught in a clamp applied close to the muco-cutaneous juncture. Each section is excised above the clamp and the membrane brought together with a cobbler's stitch, as in the Thomas operation. The wound margins are touched with the actual cautery at the completion of suturing. This is, however, a "closed" method and, therefore, an undesirable procedure.

Wheeler (33) describes an operation that is similar in principle to the above. He prolapses the mass and grasps a segment of its base with a clamp applied close to the muco-cutaneous juncture transversely to the long axis of the bowel. Following excision of the section surmounting the clamp blades the wound is closed by the method of Mitchell, previously referred to. Successive segments are treated in like manner, until the entire mass is removed. Wheeler states that an excision as extensive as that of Whitehead can be performed by this procedure and that primary union will result. He claims that this circumferential suture does not cause stricture because of the accuracy of the approximation. But this measure has no greater claim to freedom from infection than many other "closed" methods. Stricture may be less frequent than with the Whitehead operation, but while primary union may be hoped for, it can not be expected. This method is also open to the objections previously raised against the Mitchell closure.

None of the measures ordinarily described can be considered satisfactory for the removal of the encircling mass. Good results are obtained with present measures, but they are secured, however, with no gratifying consistency. When they occur they do so in spite of rather than because of the methods utilized. The procedures in use in this connection offer an insufficient assurance of uniform success because they do not conform to the principles that experience has demonstrated to be surgically correct for removals in this area. The measures that adequately reflect these principles, such as the operation of Montague, Hirschman, Martin, etc., appear to be unsusceptible of any modifications that might render them suitable for the type of removal under discussion. Satisfactory treatment in this regard would, therefore, seem to await the modification of one of the

methods now employed in connection with extensive removals or upon the development of an entirely new procedure.

Longitudinal excisions, in the long axis of the bowel, are generally considered as least likely to invite stricture. The complete removal of an encircling tumor is, however, apparently impossible by other than circumferential excision, and successful treatment appears to require the acceptance of this seemingly unavoidable conclusion. And the principle utilized by Bell and Wheeler would seem to afford the best possibilities of success. They prolapse the mass to the desired extent, as has been shown, and excise the tumor at its base. Such a removal can be just as complete as a Whitehead excision and there are certainly fewer objections that may be raised against it. The Whitehead operation produced an extensive area of damaged tissue as a result of the dissection performed, and the principle of dropping a curtain of mucous membrane over such an area is a definite invitation to infection. A contaminated field is thereby closed. A basic surgical principle is thereby antagonized. Damaged and devitalized areas are undesirable and dissections and closures are improper. The retractions and strictions which followed the Whitehead operation resulted from a disregard of these factors. The Bell and Wheeler methods leave no extensive areas of damaged tissue. Retractions and strictures can not therefore be so common. If the induced prolapsing is not too great, there should be little tension present to antagonize satisfactory union. But these procedures are faulty in that suture closures are used. The method of Wheeler is also lacking in adequate hemostasis. The use of crushing clamp pressure is undesirable in both. But these operations go a long way in the right direction and furnish better points of departure than most of the others. The method of suturing described by the writer affords a most satisfactory routine in connection with an excision of the Wheeler type. The "three-needle" method (with a great number of needles, of course) and the suture ligation of Bookman may also be advantageously applied in this connection. The last two are, however, open to the objections previously noted and may therefore prove less satisfactory in special circumstances.

It will occasionally be discovered that the original clamp application in a circumferential excision is rather difficult of execution when an especially large encircling mass presents. A properly aligned initial grasp is practically impossible at times with the older methods. The measure below described is intended to offset this difficulty in a bloodless manner and afford a more accessible field for operation, in addition to accounting for many of the desiderata already discussed.

## BLOODLESS OPERATION FOR ENCIRCLING HEMORRHOIDAL MASSES

Two straight clamps are applied to the mass, as illustrated in Figure 4, so that their tips reach the neighborhood of the contemplated line of excision. The instruments are not parallel to each other but diverge somewhat toward the outer circumference of the mass as do the spokes of a wheel. The blade tips of clamp No. 1 extend slightly beyond those of clamp No. 2, to somewhat overlap the latter with a narrow strip of tissue (one-fourth inch) interven-

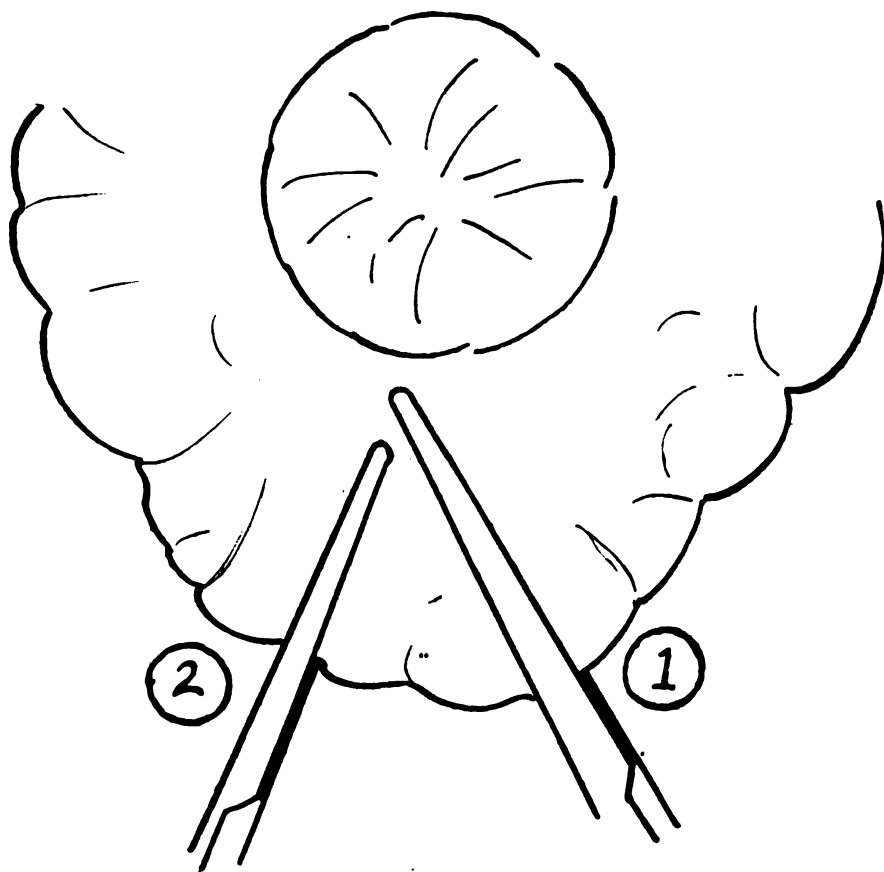


FIGURE 4

ing. Sphincter inclusion is avoided by rolling the tumor base between the fingers as clamp pressure is applied. The small triangular sector of tumor between these instruments is then excised, using the clamp blades as guides for the knife edge. A narrow-bladed, curved clamp is now inserted between the tips of instruments Nos. 1 and 2 to grasp the tumor base along the contemplated line of excision, close to the mucocutaneous juncture, as shown in Figure 5. This clamp is transverse to the long axis of the bowel and is applied with a pressure only sufficient to gently approximate and maintain the two membranous surfaces of the base in a satisfactory position for suture ap-

plications and to serve as a guide for the introduction of the needle. This mode of application is intended to eliminate crushing injury to the mucous membrane as in the writer's operation for discrete masses. A third straight clamp is next applied at the other extremity of the segment to be removed, as illustrated in Figure 5. The blade tips of this instrument have the same relationship to those of the curved clamp as No. 2 clamp has to No. 1, in Figure 4.

Interlocking sutures are now introduced as described in the operation for discrete masses. These are secured and the transverse clamp is removed and reapplied prior to excision as previously outlined.

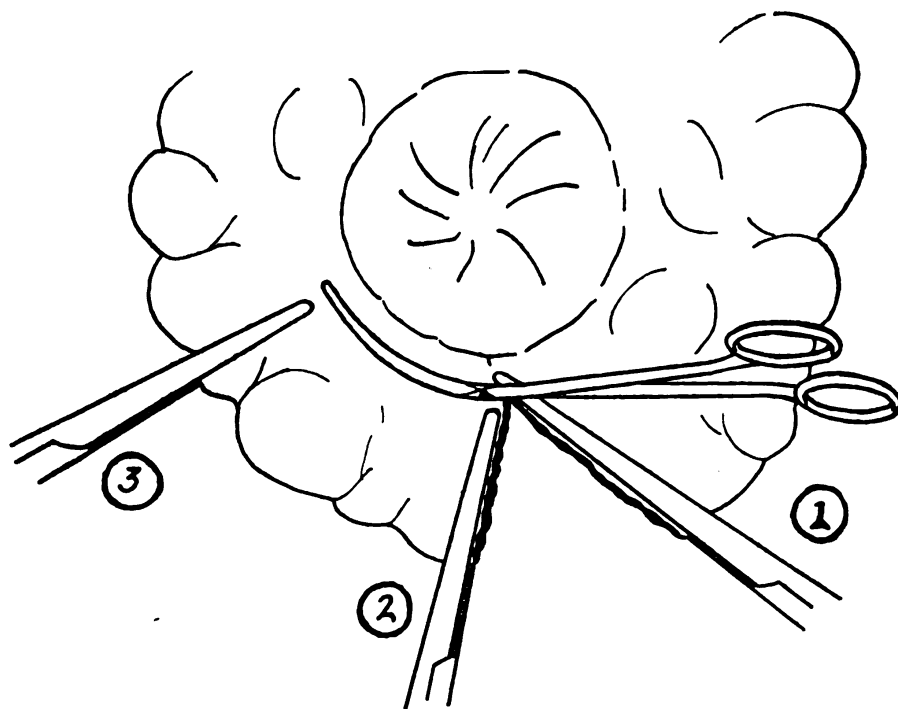


FIGURE 5

The needle should be introduced from within outward so that the knots may be placed on the external side of the suture line. The segment of tumor above the transverse clamp is now excised, using the blades of the same and those of the No. 3 instrument as guides for the knife edge. The entire circumference is treated in like manner, and four such excisions usually suffice for the most extensive involvements. A somewhat larger curved clamp may be advantageously used for an especially patulous anal orifice. Subsequent applications of this instrument are made between the blade tips of the clamp represented by No. 3 and the termination of the suture line. The clamp represented by No. 1 is dispensed with in all but the initial segment excision. Its function is, of course, performed by the line of sutures.

The above measure transforms what has heretofore frequently amounted—for those of limited experience, at least—to a rather extensive and not altogether hazardless undertaking into a relatively simple and safe procedure. The most extensive masses may be thus removed without risk. Bleeding during operation is negligible. The method of application of clamps Nos. 1 and 2 reduces oozing prior to the placing of the transverse clamp to a minimum. Postoperative hemostasis is absolute. The method of transverse clamp application eliminates crushing mucous membrane injury, preventing devitalization of tissue and postoperative membranous oozing. Serious or troublesome wound infection is prevented by the method of suture-ligation, which is essentially an "open" one, and by the absence of any extensive area of damaged tissue. The possibility of subsequent retraction and stricture formation is slight if the suture tension is not too great.

Circumferential ligation with an interlocking suture may be attacked on the grounds that a narrowed lumen may result. If, however, the method described by the writer is properly applied, there is very little pursing of the suture line. It is also well to remember that in many cases the anus is more patulous than normal and any tendency toward pursing would not be undesirable under such circumstances. It is not, however, considered essential or perhaps desirable that the interlocking suture be used in all cases. Its special function is blood conservation, and it should be used whenever this factor is of vital importance. When the anus is normal and pursing is feared the method of Bookman, without interlocking, is a most excellent measure. It is easier and more rapid of introduction than the suture described by the writer. The exception to its use is, of course, the presence of the necessity for absolute and certain hemostasis.

#### SUMMARY AND CONCLUSIONS

1. Operative procedures are superior to nonoperative procedures for the treatment of hemorrhoids in average hands. Operation is safer, surer, more rapid, and more permanent. Nonsurgical measures should be best utilized only by those especially experienced in their employment. They should never be used in other than simple and uncomplicated cases in any event.
2. The clamp and cautery method should be avoided in general work. When it is used, if at all, its application should be restricted to ulcerated, gangrenous, or thrombosed masses of limited number and size.
3. The Whitehead and Pratt operations should be permanently abandoned.



4. Operation is indicated in all cases giving rise to symptoms, with the following exceptions. It should be deferred in the presence of ischio-rectal abscess and other acute infective anorectal conditions. It should also be deferred, when possible, to await transfusion or general tonic measures in the presence of a dangerously low hemoglobin percentage. Malignancy, of course, demands primary attention over all other considerations, when present.

5. The principles that govern satisfactory hemorrhoids surgery are, in a broad sense, those underlying successful operative work in general. The stipulations of Warbasse and Hirschman may serve as a basis for outlining the qualifications of an approved procedure, as follows:

(a) That it should effect a complete removal of all diseased tissues.

(b) That it should be simple in performance and expeditious of execution.

(c) That it should be safe in ordinary hands.

(d) That it should insure effective operative and post operative hemostasis.

(e) That it should invite the least infection.

(f) That it should effectually minimize shock.

(g) That it should preserve or restore physiological function.

(h) That it should admit of the fewest possibilities for undesirable aftermaths.

6. Some practical suggestions for the observance of the foregoing principles may be found in the following recommendations and admonitions:

(a) Use "open" methods of operating only.

(b) Avoid dissections.

(c) Use "ligation" operations only.

(d) Tie before cutting.

(e) Avoid the use of crushing clamp pressure.

(f) Avoid unnecessary trauma of any kind.

(g) Never divulse the sphincter.

(h) Avoid the persistence of extensive "raw" areas.

(i) Avoid the transfixion of blood vessels.

(j) Avoid measures inviting sloughing.

(k) Avoid the inclusion of too much tissue within the grasp of any ligature.

(l) Avoid undue tension in approximating wound margins.

(m) Avoid the padded rectal tube.

(n) Use mercurochrome before and after operation.

7. The most logical conclusions with respect to the subject of anaesthesia would seem to be summarized in the following:

(a) Sacral anæsthesia is the method of choice, except when mental shock is feared.

(b) Avoid general anæsthesia, except when mental shock is feared or when sacral injection fails and local infiltration is contraindicated.

(c) Avoid local anæsthesia, except in the minor and uncomplicated involvements or when sacral injection fails.

(d) Avoid transsacral injections.

(e) Spinal anæsthesia has no place in hemorrhoids operations.

8. The outline of operations for use of the occasional surgeon, suggested below, is believed to afford the advantages over current methods previously discussed.

Pedunculated and other minor tumors.  
Moderate-sized discrete masses.

Simple ligation with excision.

Ligation with transfixion, with or without preliminary circumcision, followed by excision. (Mathew's operation.)

Montague operation.

Hirschman operation.

Large discrete masses in cases in which minor blood loss is not feared.

Writer's operation for discrete masses with Bookman or Reader method of suture introduction (with or without interlocking).

Large discrete masses in cases where blood conservation is vital.

Writer's operation for discreet masses.

Encircling tumor in cases with normal anal lumen in which minor oozing is not feared.

Writer's operation for encircling tumor with Bookman suture (without interlocking).

Encircling tumor in cases in which blood conservation is vital, or in which anal orifice is unusually patent.

Writer's operation for encircling tumor.

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**PERMISSIBLE RADIATION EXPOSURE IN RADIOGRAPHY AND  
FLUOROSCOPY**

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The number of radiographs and the amount of fluoroscopy that may be given without ill effects to the patient is a question of grave importance to the radiographer. It has been considered worth while to discuss a method of determining with reasonable accuracy the exact amount of radiation that may be administered without causing a skin reaction.

In the early days of radiography when glass X-ray plates were used the danger of X-ray dermatitis from diagnostic overexposure was a very real one, and the number of plates that could be taken of certain parts of the body was so limited that unless satisfactory plates were secured at the first exposure, it was hazardous to repeat the exposure until at least three weeks' time had elapsed. Thus, using the factors given in the United States Army X-ray Manual (1) for an antero-posterior exposure of the head; namely, 5-inch spark gap (equivalent to 87 KVP), 40 milliamperes of current, target-plate distance 20 inches, time 12 seconds, more than two plates at one exposure would have caused epilation and an X-ray dermatitis.

The introduction of intensifying screens increased by about three times the number of radiographs that could be taken. Double-coated, or duplitized, X-ray films increased the number of radiographs that could be taken about two times, and with modern X-ray technique, using double intensifying screens and duplitized X-ray films, but not the Bucky diaphragm, approximately fifteen times the number of radiographs may be taken, as compared with the glass X-ray plate, before the amount of radiation will reach a point sufficient to cause any X-ray dermatitis. The introduction of the Bucky diaphragm produced better radiographs by eliminating most of the secondary radiation in thick parts, but caused an increase in the length of exposure time from three to six times above that of double screens and duplitized films. The use of filtration allows a decided increase in the number of radiographs that can be taken without causing a skin reaction, the exact figure depending upon the wave length employed and the thickness of the filter used. The use of a one-half millimeter aluminum filter does not impair the photographic quality of the radiograph to an appreciable degree nor does it increase the exposure time, while with a 1-millimeter aluminum filter it is almost impossible to detect the difference photometrically.

No way has yet been found in fluoroscopy to increase the time a patient may be safely exposed beyond the rigid standards which have prevailed from the inception of fluoroscopy. In this connection,

the Army X-ray Manual (1) states: "Thus at 5 milliamperes, 5-inch gap, 20 inches, 1 mm. al., a total of 12 minutes may be used on one skin area for fluoroscopic examination, if no radiograph is to be taken."

The United States naval hospital, San Diego, Calif., in fluoroscopy uses a Rieber unit. With this unit  $\frac{1}{2}$  mm. al. filtration is employed; the target skin distance varies from 15 inches to 21 inches; 4 ma. of current are used to energize the tube at 87KVP, or 5-inch spark gap. With the above factors at 15-inch target skin distance, an exposure of 12 minutes will cause an erythema or definite first degree X-ray dermatitis.

An erythema, or skin toleration dose, is that amount of radiation that will produce a defluvium of the scalp hair in three weeks, or a pronounced reddening of the skin in a young blond on some sensitive area in about five to seven days after radiation, reaching a maximum intensity in 10 to 14 days, then gradually fading, leaving a pigmented spot for some weeks.

An erythema dose is an indefinite quantity, as many factors enter into the biological reaction of the skin. While there is no true idiosyncrasy to radiation, there are wide variations in susceptibility to radiation in the skin in different individuals and on different parts of the same individual. Susceptibility to radiation is influenced by age, sex, texture of skin, complexion, part of body treated, circulation in part treated, and previous application of skin irritants or radiation, or irritant applications after radiation. MacKee (2) gives instances of erythema caused by as little as one-fourth an erythema dose. Of 210 patients treated, 11 (5 per cent) developed erythema with one-fourth unit, and 46 per cent developed pigmentation with one-fourth unit. Another difficulty in judging of an erythema dose is in selecting the exact shade of reddening that may be considered as an erythema. Different authorities use different standards as to the degree of reaction which they consider an erythema.

Aside from biological variations, the physical variations of wave lengths from different types of generating apparatus make it difficult to transfer the known factors giving rise to an erythema from one installation to another. The output of X rays from Coolidge tubes without filtration vary as much as 66.5 per cent and with filtration 12.9 per cent. MacKee and Andrews (2) tested 10 medium-focus, universal-type, Coolidge tubes and obtained a maximum difference of 57.8 per cent in the output of unfiltered radiation as shown by ionization measurements. The skin effects conformed to the ionization results to some extent, but attention is called to the

fact that an ionization difference of as much as 100 per cent may produce a difference in visible skin reaction that a clinical observer might call slight or moderate.

X rays are filtered by the glass wall of the X-ray tube, and with the ordinary universal type of X-ray tube there is very little radiation emitted with voltages under 30,000. Increasing the voltage not only causes a decrease in the wave length but raises the total quantity of radiation. Penetration through human tissues increases rapidly from 64 to 98 KVP; beyond 98 KVP penetration increases more slowly. Filtration does not affect the shorter, more penetrating wave lengths to the same extent as the longer wave lengths, and for wave lengths generated by from 64 to 98 KVP, those used in radiography and fluoroscopy, filtration removes longer wave lengths that are absorbed in the superficial layers of the skin and have little or no penetrating effect. The quality of the radiograph is thus practically unaffected by filtration through  $\frac{1}{2}$  mm. al. and hardly perceptibly affected by filtration with 1 mm. al. The increased number of radiographs that can be taken by the use of filtration is obviously a marked advantage.

While the limitations of the erythema dose should be recognized clearly, the skin toleration dose is the only satisfactory standard devised that has stood the test of time, and it is to this standard that all other standards are compared. Physical standards, and standards based on chemical changes, are not adapted to routine use in radiography or fluoroscopy.

Roentgen radiation has certain definite physical laws, and these must be thoroughly understood before any one set of factors can be applied. The primary laws are few.

1. The quantity of radiation varies directly as the milliamperage and time. Double the milliamperage and the same quantity of radiation will be produced in one-half the unit of time, other factors being equal. Half the milliamperage, and it requires twice as many units of time to produce the same quantity of radiation.

2. The penetrating power, and the biological and photometric effect are directly proportional to the square of the voltage, other factors being equal. This is not strictly true either photometrically or biologically, but with voltages from 64 KVP to 150 KVP this law is so nearly true that for purposes of arithmetical computation it may be regarded as correct.

3. The quantity of radiation varies inversely as the square of the distance. Halving the distance produces four times the amount of radiation; doubling the distance, one-fourth the amount of radiation.

Putting these factors into the form of an equation, a formula can be given: Milliamperes X voltage squared X sufficient time, divided by target-skin distance squared, is equal to one erythema skin dose.

$$\frac{MA \times V^2 \times T}{\text{distance}^2} = 1 \text{ E. S. D.}$$

At the United States naval hospital, San Diego, Calif., the following basic factors were established by biological experiment for the ordinary skin on the flexor surface of the forearm: Milliamperage 5, voltage 87,000, time 140 seconds, target-skin distance 10 inches, over a field 1 square inch, with a certain broad focus universal type of Coolidge X-ray tube. Forty-eight hours after radiation, by applying hot cloths for five minutes to the treated area, a definite reddening is seen. This reddening may fade to normal color or persist faintly. From five to seven days later a permanent reddening occurs. This erythema increases in intensity for the next seven days, then gradually fades, leaving a slight pigmented spot which persists for some time. The same amount of radiation applied to an area on the scalp will cause epilation to start in two or three weeks time. A large amount of the hair falls out, but regrowth commences within three months' time and practically all the hair returns, although sometimes of a different shade and texture; the hair generally returns darker and coarser, and straight if formerly wavy.

Expressed graphically, the formula given above, which has been adopted for our erythema dose is

$$\frac{5 \times 87^2 \times 140}{10 \times 10} = 52,983 = 1 \text{ E. S. D.}$$

Increasing the time factor to 2 minutes and 45 seconds with the other factors as given in the formula, produces a pronounced erythema in four to five days. Defluvium of the scalp occurs regularly within three weeks and all the hair does not return by the end of six months.

MacKee (2) gives the following factors as established for an erythema skin dose: 3 milliamperes of current, 64 KVP, 8-inch target-skin distance, 5 minutes time; or graphically,

$$\frac{3 \times 64^2 \times 5}{8 \times 8} = 960 = 1 \text{ E. S. D.}$$

If the number of seconds, 300, is substituted for 5 minutes, the equation becomes 1 E. S. D. = 57,600. The factors given by MacKee have been accepted since 1916 by dermatologists generally as one erythema skin dose.

As the figure we established was for a specific X-ray outfit with a specific X-ray tube, for general computation, MacKee's figures as



transposed to 57,600=1 E. S. D., are preferable. As we desired to determine the largest number of radiographs that could be taken consistently without causing a skin reaction, four-fifths of the standard erythema dose, or 46,080, was selected as the largest amount of radiation it was advisable to administer in taking radiographs over a short period of time. This allowed for patients of various ages and uncertain history of previous radiation exposure. Every patient before being radiographed is asked about previous radiation exposure, but we have found that the replies received are not always reliable. Up to date, we have been very fortunate in not having had any untoward skin reactions or other ill effects from radiation administered in this hospital.

Beets and Arens (3) checked with ionization measurements the effect of filtration of various thicknesses of aluminum from one-half millimeter to 2 millimeters, for wave lengths generated by voltages equivalent to from 3-inch spark gap to 8-inch spark gap, i. e., 64 KVP to 120 KVP. From their figures a table has been arranged showing the factors to be applied for various voltages, from 64 KVP to 120 KVP, using  $\frac{1}{2}$  mm. al. and 1 mm. al. filters.

TABLE A

Spark gap	KVP	$\frac{1}{2}$ mm. al.	1 mm. al.
3	64	1.70	2.40
4	77	1.65	2.30
5	88	1.60	2.13
6	98	1.50	1.95
7	109	1.40	1.80
8	120	1.40	1.80

A formula may be devised for filtered or unfiltered radiation that will determine the maximum number of radiographs that may be taken, or maximum exposure that may be given, without causing a skin reaction.

$$\frac{MA \times V^2 \times T \times N}{TSD^2} = 46080 \times K$$

where *MA*. = milliamperage.

*V*<sup>2</sup> = kilovoltage peak squared.

*T* = time in seconds for one radiograph.

*N* = maximum number of radiographs that may be taken.

*TSD*<sup>2</sup> = target skin distance in inches, squared.

*K* = factor to be used if filtration is employed.

From the above formula, Table C was derived, using data from Tables A and B.

Table B is the X-ray exposure table used for radiographs at the United States naval hospital, San Diego, Calif. Duplitzed safety X-ray films are used exclusively and time of exposure is calculated for a 150-pound patient.

TABLE B

Part	Position	TSD in.	Sp. G. in.	KVP	MA	Time		
						Sec.	Sec. Do. Sc.	Sec. Do. Sc. Bucky
Fingers.....	Ap-lat.....	25	3	64	10	2½	½	-----
Hands—carpals.....	Ap-lat.....	25	3	64	10	4½	5⁄8	-----
Wrist.....	Ap-lat.....	25	3	64	10	5½	¾	-----
Elbow.....	Ap-lat.....	25	4	77	10	7	1	-----
Shoulder.....	Ap.....	25	5	87	10	6½	¾	3¾
Toes.....	Ap.....	25	3	64	10	2½	½	-----
Feet—tarsals.....	Ap.....	25	3	64	10	5½	¾	-----
Ankle.....	Ap.....	25	4½	82	10	3½	¾	-----
Do.....	Lat.....	25	4	77	10	3¾	½	-----
Knee.....	Ap.....	25	5	87	10	5½	¾	-----
Do.....	Lat.....	25	5	87	10	5	¾	-----
Hip—pelvis.....	Ap.....	25	6	98	10	16	2	10
Spine—cervical.....	Ap.....	25	4	77	10	12	1½	7½
Do.....	Lat.....	40	5	87	10	22	2¾	14
Spine—thoracic.....	Ap.....	25	6	98	10	10	1¼	6¼
Do.....	Lat.....	30	6	98	10	15	1¾	9
Spine—lumbar.....	Ap.....	25	6	98	10	17	2	10
Do.....	Lat.....	30	6	98	10	29	4	20
Head.....	Ap.....	25	6	98	10	24	3	15
Do.....	Lat.....	25	5	87	10	16	2	10
Kidney.....	Ap.....	25	5	87	10	17	2	10
Gall bladder.....	Pa.....	25	5	87	10	16	2	10
Gastrointestinal tract.....	Pa.....	25	6	98	10	6	¾	4
Chest.....	Pa.....	40	5	87	10	8	1	-----
Heart.....	Pa.....	84	6	98	10	28	3½	-----
Do.....	Lat.....	84	6	98	10	56	7	-----

Table C is calculated for average radiation exposure for each radiograph and the number given as permissible does not allow for any elimination of radiation effects due to lapse of time between radiographs. This number is the maximum number of radiographs it is advisable to take in three weeks' time. In computing this table, the thickness of the part taken was deducted from the target-film distance, and maximum measurements were used.

TABLE C

Part	Position	Th. pt. in.	No screens			Double screens			Bucky double screens		
			No filter	½ mm. al.	1 mm. al.	No filter	½ mm. al.	1 mm. al.	No filter	½ mm. al.	1 mm. al.
Fingers.....	A. p. lat.....	1	258	439	619	1,936	329	4,646	-----	-----	-----
Hands—carpal.....	A. p. lat.....	2	132	224	317	950	1,615	2,280	-----	-----	-----
Wrist.....	A. p. lat.....	2½	103	175	247	768	1,306	1,843	-----	-----	-----
Elbow.....	A. p. lat.....	3	53	87	122	375	619	833	-----	-----	-----
Shoulder.....	A. p.....	8	27	43	57	234	374	498	47	75	100
Toes.....	A. p.....	1	258	439	619	1,936	3,291	4,646	-----	-----	-----
Feet—tarsals.....	A. p.....	3	99	168	238	726	1,334	1,742	-----	-----	-----
Ankle.....	A. p.....	11	38	62	84	355	574	779	-----	-----	-----
Do.....	Lat.....	3	100	165	230	755	1,246	1,737	-----	-----	-----
Knee.....	A. p.....	5	48	77	101	328	525	699	-----	-----	-----
Do.....	Lat.....	4	54	86	114	360	576	767	-----	-----	-----
Hip—pelvis.....	A. p.....	10	6	10	12	54	80	97	10	16	19
Spine—cervical.....	A. p.....	9	14	21	27	112	168	215	22	33	43
Do.....	Lat.....	18	13	21	25	107	171	219	21	34	44
Spine—thoracic.....	A. p.....	10	10	16	21	88	132	172	17	26	34
Do.....	Lat.....	18	4	7	9	39	58	76	8	12	15
Spine—lumbar.....	A. p.....	11	5	8	11	47	70	91	9	14	18
Do.....	Lat.....	14	4	6	8	30	46	60	6	9	12
Head.....	A. p.....	9	4	7	9	36	54	70	7	11	14
Do.....	Lat.....	8	11	17	23	88	140	187	17	28	37
Kidney.....	A. p.....	10	8	14	18	67	109	146	13	22	29
Gall bladder.....	P. a.....	10	8	13	17	67	109	146	13	22	29
Gastrointestinal tract.....	P. a.....	10	18	27	35	144	216	281	29	43	56
Chest.....	P. a.....	10	68	109	145	548	877	1,167	-----	-----	-----
Heart.....	P. a.....	10	93	140	183	750	1,125	1,322	-----	-----	-----
Do.....	Lat.....	18	37	56	72	298	447	564	-----	-----	-----

The number of permissible radiographs, using double screens and 1 mm. al. filtration, appears very large, but the proof of any number given is determined easily by the use of the basic formula.

$$\frac{\text{milliamperes} \times \text{kilovoltage peak squared} \times \text{number}}{\text{target-skin distance squared} \times 46,080 \times \text{filter factor}}$$

For a chest, using double screens and 1 mm. al. filtration the equation becomes:

$$\frac{10 \times 1 \times 7,569 \times N}{900} = 46,080 \times 2.13. \quad N = 1,167.$$

Should no screens and no filtration be used, radiographs in some parts of the body are restricted to only four exposures.

The actual time current was passing in a considerable number of gastro-intestinal fluoroscopic examinations was accurately determined with a stop watch. Using 4 milliamperes of current, at 87 KVP., the time did not exceed three minutes in any case tested. Every precaution is taken to use the minimal amount of time possible, and yet arrive at a satisfactory diagnosis, by flashing the current on and off. Ordinarily four films are taken in a case negative in fluoroscopic examination, and from 8 to 10 films are taken in a case showing suspected pathology. A routine gastro-intestinal examination, therefore, without a barium enema, receives approximately one-fourth skin unit dose in fluoroscopy with negative findings and in fluoroscopy with suspected pathology approximately one-third skin unit dose. If a barium enema is given, a two-thirds skin unit dose is approached. It is still possible to follow the examination with a gall-bladder series, if desired, without danger of overradiation to the patient, but any additional exposure would be hazardous. The use of a 1/2 mm. al. filter is required for all radiographic and fluoroscopic work. If it is desired to use a Bucky diaphragm, at least two weeks should intervene between the gastro-intestinal series and a gall-bladder series.

The elimination of radiation effects in the tissues owing to elapse of time between radiation exposures was not considered in the computation of Table C. Where the condition of the patient is such that additional radiographs are imperative for diagnosis the elimination of radiation may be taken into account. Pfahler and Widman (4) have prepared a graphic chart showing the saturation curve for use with unfiltered rays, using 18-cm. (7-inch) parallel spark gap (0.35 A. U. mean wave length) for superficial skin effects determined upon the basis of a repetition of a full erythema dose in approximately 14 days. According to this chart, it is practical to administer a 50 per cent of a toleration dose after an interval of three and a half days or 75 per cent of a toleration dose after one

week. Such doses can not be administered indefinitely or often repeated. There is considerable danger of atrophy, endarteritis, and late degenerative processes following overdosage.

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#### A STUDY OF THE INCIDENCE OF AMEBIASIS CARRIERS AMONG NATIVE DOMESTICS OF HAITI

By L. H. WILLIAMS, Lieutenant Commander, Medical Corps, United States Navy, and J. A. THOMAS, Pharmacist's Mate, First Class, United States Navy

Payne (1) and his coworkers found in a health survey of Haiti, made under the auspices of the International Health Board in the spring of 1925, that from 11 to 26 per cent of the natives around Port au Prince were carriers of *Endameba histolytica* cysts. The percentage varied in the different localities examined. He states, "It is probable that in some areas a higher incidence of intestinal protozoa would have been found had it been possible to examine fecal specimens immediately after they were prepared." He does not state the technique followed in the examinations.

Williams, Wildman, and Curtis (2), of the Public Health Service of Haiti, in a survey of intestinal protozoa among the natives of Cape Haitien in the summer of 1928, found a much higher incidence of *Endameba histolytica* infection in the vicinity of Cape Haitien than reported by Payne to be existent among the natives around Port au Prince. The method followed in the survey at Cape Haitien was the concentration and sedimentation technique of Yorke and Adams as advocated by Craig (3). This method, while time consuming, is nevertheless excellent, and enables one to detect cysts of protozoa in stools which, if examined with the simple iodine staining, would be declared negative for cysts. The incidence of *Endameba histolytica* carriers around Cape Haitien was reported by them to be between 42.8 and 44.2 per cent in the two largest groups of natives examined.

It is generally accepted by competent observers that amebiasis is contracted by the ingestion of the cysts of *Endameba histolytica*. The ingestion of these cysts is mainly by way of contaminated food and water. The manner in which this contamination occurs varies in different countries. It may be that feces of carriers of *histolytica*

cysts are washed by rain into the crevices of vegetables, or that such feces are carried along with the rain water into streams and wells, from which water for drinking purposes is obtained. But it can hardly be questioned that a considerable percentage of people with amebiasis have contracted the infection through food and water contaminated with cysts from the hands of human carriers.

The not infrequent occurrence of amebic dysentery among Caucasian residents and visitors to Haiti, who were not exposed to food and water contaminated by other than hand contact of carriers, led us, in the light of the known high incidence of amebiasis infection in the native population, to begin a study of the possible carriers among the food-handling domestics of Haiti. The study was made at the Justinien Hospital, Cape Haitien. The method of concentration and sedimentation devised by D. de Rivas (4) was followed. The technique of this method is simple, and the morphology of the cysts and ova thrown down are not changed by the process.

One hundred and eight food-handling domestics were so studied for intestinal protozoa. Particular attention was given only to the determination of *Endameba histolytica* cysts. Once their presence was determined, no further search was made for other protozoa or nematode infection.

The percentages of the several cysts and ova noted during the study is set forth in Table No. 1.

TABLE NO. 1

	Per cent
<i>Endameba histolytica</i> .....	50
<i>Endameba coli</i> .....	60.19
<i>Giardia lamblia</i> .....	6.4
<i>Ascaris lumbricoides</i> .....	12.03
Hookworm.....	5.08
<i>Trichomonas</i> .....	1.8
<i>Trichiuris</i> .....	34.2
Negative for ova and parasites.....	3.7

At the commencement of this survey it was our purpose to treat all individuals found positive for ova and infective protozoa. It was found, however, to be impracticable to obtain the cooperation desired. Only 41 of the 54 persons found to be carriers of *Endameba histolytica* cysts reported for treatment after notification to their employers that their food-handling domestics were carriers of *histolytica* cysts. Those carriers who reported were given chenopodium and castor oil to rid them of their nematodes and prepare the intestinal tract for the eradication of the *Endameba histolytica*. Five grains of yatren taken three times daily was thought to be sufficient to accomplish this. The yatren was given to the employers to personally administer to their domestics. At the expiration of this period a reexamination was requested. Thirty-four of the forty-one reported

for examination at the end of the initial five days' treatment. Of these, six, or 17.6 per cent, were found to still harbor *histolytica* cysts, though the number of cysts was much reduced.

The remaining six carriers were subjected to another five days' course of yatren and again examined at the expiration of this time. Five were found to be negative. The one remaining carrier was subjected to a more vigorous therapy, consisting of paroxyl, bismuth subnitrate, and daily yatren enemata. He was examined daily till no cysts were found. After two days of this treatment no *histolytica* could be discovered, but the field was full of *Endameba coli* cysts. On the third day not a cyst could be discovered. Three subsequent daily examinations failed to demonstrate any cysts and he was declared negative. The fact that only 41 of the individuals found to be carriers reported for treatment was due, in part, to indifference on the part of their employers and to native superstition and fear of what was intended. That every one of the 34 who reported for examination at the end of the initial treatment was eventually freed of the infective *histolytica* cysts with little discomfort to him and expense to the hospital shows that it is practicable to render these carriers noninfective. The indifference of employers and lack of cooperation among the carriers who did not report for treatment and reexamination demonstrates that the menace of amebiasis to those employing native servants is a reality to be overcome only by education and insistence on the examination of all food handlers, those found to be carriers to be freed of their infection before being allowed to handle food.

Two months after the completion of this study 26 of these people were again examined. Of 14 former positives, 1 was found to be again a carrier; of 12 who were originally negative and had therefore received no yatren, 1 was found positive for *Endameba histolytica* cysts. These two positives were again subjected to five days of yatren and at the end of this time were found to be negative. Whether the cysts discovered on this reexamination were reinfection or simply missed at the examination following treatment in the first case or whether the infection demonstrated in the originally negative individual was due to oversight or an infection acquired since the examination we are not able to determine.

The results of this examination two months after completion of treatment are tabulated in Table No. 2.

TABLE NO. 2

	Per cent
<i>Endameba histolytica</i> .....	0. 77
<i>Endameba coli</i> .....	42. 3
<i>Trichiuris</i> .....	23. 07
Hookworm.....	. 77

## SUMMARY

1. The occurrence of amebiasis among Caucasian residents and visitors to Haiti, who had not before been aware of any chronic intestinal disturbance, or previously found to harbor *Endameba histolytica* cysts, and who were not exposed to the infection here other than the hand contact by native food handlers, led to this study.

2. One hundred and eight food-handling domestics were examined for the presence of *Endameba histolytica* cysts. The method of D. de Rivas was used in the examination. Fifty-four, or 50 per cent, were found to be carriers of *Endameba histolytica* cysts.

3. Owing to lack of appreciation on part of employers and fear of what was intended on part of the people examined, only 34 of the positives cooperated to the extent desired. These were all eventually freed of the protozoa.

4. Two months later 26 of the original group examined were induced to be reexamined. Of 14 original positives, and rendered free of *histolytica* cysts, one was found to be again positive for *histolytica* cysts. Of 12 original negatives, and so not treated, one was found to harbor the *Endameba histolytica*. These two persons were treated and rid of their infection.

5. Six of the 108 originally examined had vegetative forms as well as cysts. Their stools were very loose and they gave a history of alternating diarrhea and constipation.

6. All of the proved carriers were eventually made noninfective. How long they will stay so is problematical.

7. The high incidence of amebiasis carriers demonstrated in this study to be present among the food-handling domestics of Haiti, makes it advisable that these people be carefully examined for the presence of the infection, and those found positive to be freed of the cysts before being employed as such domestics. That two months after the completion of the first study, two individuals formerly examined, and declared negative, one after having been found to be a carrier, and after treatment found free of cysts, should again show *Endameba histolytica* cysts, makes it advisable that food-handling domestics be examined at intervals of a few months.

8. The comparative ease with which all proved carriers were freed of their cysts by the new compounds, yatren and paroxyl, is a hopeful indication that ere long progress can be made in the eradication of this tremendous reservoir of amebiasis infection. To accomplish this, however, effective sanitation will have to accompany treatment and for some years to come this will be impracticable in the country districts of Haiti.

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**SULPHARSPHENAMINE—A CLINICAL REPORT<sup>1</sup>**

By P. R. STALNAKER, Captain, Medical Corps, United States Navy

In 1923 the writer was suddenly confronted with the desirability of using an arsenical preparation suitable for intramuscular administration in several patients whose veins were either inaccessible or invisible, as in infants, obese persons, women, etc. Sulpharsphenamine had recently been placed on the market and it was decided to try it. The results were so pleasing that it has been used regularly. The following deductions are based on the clinical observations in over 500 cases. It has been noted that the products from different manufacturers seem to vary, and also that the recent product appears more desirable in every way.

Sulpharsphenamine is now manufactured by several firms in this country at a price about the same as that of arsphenamine and neoarsphenamine. It is more stable both in dry form and in watery solution than either of these other two arsenicals. It is very soluble in water and is easy to administer. It is best given in very concentrated solution. It requires no alkalization.

Several recent writers emphasized the fact that sulpharsphenamine is superior in clinical results to both arsphenamine and neoarsphenamine when given intramuscularly, whereas it is inferior to both the latter when given intravenously. This has also been my observation. However, it is difficult to account for this difference when it is realized that experimentally on lower animals all three are more trypanocidal and spirocheticidal when given intramuscularly than when given intravenously. But the local reactions are too severe in the first two so that sulpharsphenamine is the only one clinically available for the intramuscular route.

The arsenical percentage contents of the three are approximately as follows: Arsphenamine, 24 per cent; sulpharsphenamine, 22 per

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<sup>1</sup> Read before the Philadelphia Urological Society, Dec. 17, 1928.



cent; neoarsphenamine, 19 per cent. Kolmer states that 0.4 gram sulpharsphenamine is more potent than 0.4 gram neoarsphenamine. Also that sulpharsphenamine is superior in cases of chronic syphilis, especially neurosyphilis. Stokes and Behn found it superior to neoarsphenamine in cardiovascular, neural, and Wassermann fast cases. They also rate it superior to neoarsphenamine in reversing Wassermann blood and spinal reactions, in the healing of open lesions, in promoting the general well being of the patients, and as being more spirocheticidal. They advise giving it intermuscularly rather than intramuscularly.

The published objections to the use of sulpharsphenamine are that it causes skin reactions (Belding series 16 per cent, Kilmer 5 per cent, Stokes and Behn 3 per cent), and that the product of different manufacturers differs in effectiveness. In the series of over 6,000 injections here reported on, 5 skin eruptions occurred, all of which were of a mild type.

The only serious drawback in the use of sulpharsphenamine that I have found is that it causes pain in varying degree following injections. Stokes and Behn state that in their series of 1,360 injections in 126 cases extending over a period of over 14 months, 83 per cent caused no pain or local discomfort whatever. In this series of over 6,000 injections, in a period of five years, no pain or discomfort resulted in 92 per cent of the injections. This difference in percentage may well be due to better and more refined products recently supplied by the manufacturers. Less pain and discomfort have been noted from recent products than from those formerly used. Also it has been observed that certain patients are more susceptible to pain from intramuscular injections.

All the usual types of syphilis are included in this series of cases, from the chancre to the tertiary parenchymatous manifestations. The dark-field examination was made in all chancre cases. The spirochete was absent by dark field examinations after from one to three injections. Secondary skin eruptions were likewise cleared in from one to three injections. The number of injections given per patient varied considerably, depending on individual conditions and clinical necessity. No set number of injections have constituted a "course." Patients have received one or two injections on the one hand from various causes, such as change of stations, outclinic itinerants, etc.; in others the number of injections have varied from 3 to 40 in regular weekly sequence, and without rest periods in most cases.

Sulpharsphenamine is well suited for cases of infantile syphilis, congenital syphilis, obese persons and others with small invisible veins, men at sea without a medical officer or during rough weather, or on isolated stations.

In this series of cases the most brilliant results have been in the cardiovascular cases. In over 500 injections for patients with serious cardiovascular complications as myocarditis and aortic aneurysms very decided improvement was noted clinically in more than 90 per cent of them. This can not be said of other drugs in common use for these syphilitic manifestations.

Observation in this series of cases has shown sulpharsphenamine to be capable of getting chancres negative for *treponema pallida* by dark field as rapidly as neoarsphenamine, but somewhat slower than neoarsphenamine in getting the blood Wassermann negative. For Wassermann reversal this has been in the proportion of about 16 injections of neo to 20 for sulpharsphenamine. Of course, the required number of injections varies considerably, depending on the relative recentness of the infection as well as on numerous other factors.

This series of cases included the following:

	Number of injections
Chancres.....	50
Secondaries (skin and mouth).....	456
Tertiary, including all parenchymatous manifestations as nervous, cardiac, bone, cutaneous.....	5,550
All types of neurosyphilis, including paresis and tabes.....	3,472
Cardiovascular.....	543
Bone and joint.....	172
Total number of injections.....	6,000
Total number of cases.....	500

The average number of injections given was 12. The injections were given weekly as a rule, but in some cases at 5-day intervals. The dosage was 0.2 gram for the first dose, 0.3 gram the second, and thereafter 0.4 gram, this being generally the maximum dose. It was given preferably in the gluteal muscles, but for various reasons over 100 injections in this series were given in the pectoral muscles. A total of 22 abscesses formed. Sixteen followed gluteal injections and six pectoral injections. In 20 of these abscesses no infection was encountered.

The injections were given with 20-gage steel needles  $1\frac{1}{4}$  inches long, taking 30 to 60 seconds for each injection. Our practice was to dissolve every 0.1 gram of sulpharsphenamine in 0.2 cubic centimeter of distilled water. We included in each dose three drops of fresh sterile 2 per cent solution of novocaine to each 0.1 gram of sulpharsphenamine. Every detail of the technique must be executed with great care to avoid pain. If possible, patients should remain quiet, lying down following injections. Exercising the injected muscles is to be avoided. If pain ensues following injections, absolute rest in bed is preferable with constant heat to the area with

an electric heating pad. It has been found that the pain may not appear for two or three days following the injection. In cases where swelling and hard lumps form in the area of injections, rest and heat are indicated.

The rapid solubility, chemical stability, low toxicity, and relative high arsenic content of sulpharsphenamine make its administration subcutaneously, intramuscularly, and intravenously simple, safe, and effective. It can be given intramuscularly in those cases that do not stand intravenous injections of arsphenamine and neoarsphenamine. It gives excellent results in petit mal cases of luetic origin. It has a tonic effect and gives the patient a sense of well being. It quiets nervous tremulous patients. It lessens tabetic gastric pains.

The most brilliant results in this series of cases was noted in the cardiovascular cases where bedridden patients who had been given grave prognoses were literally restored to relatively good health and are now up and about, and some even pursuing their usual vocations. In serious heart lesions results have been seen that were little short of miraculous. It appears that no luetic cardiovascular condition is too serious to prevent the intensive use of sulpharsphenamine intramuscularly, whereas neo and arsphenamine and other luetic intravenous drugs are contraindicated here. In this class of cases alone, if in no other, it has earned a well merited therapeutic place.

#### SUMMARY

1. Sulpharsphenamine is safer and less toxic than the other arsenicals.

2. It is easy to administer and is the only arsenical that can be successfully given either intravenously, subcutaneously, or intramuscularly.

3. It can be used in all forms of syphilis.

4. Pain is the only disadvantage and that has been reduced by the technique described. Some patients seem more susceptible to pain than others.

5. The recent product has not caused skin eruptions.

6. It is as effective as neo in recent infections and far superior to it in old chronic cases, especially cardiovascular, neuro, cutaneous, and bone syphilis.

7. It is somewhat slower in getting the blood Wassermann negative, in the ratio of approximately 16 doses of neoarsphenamine to 20 doses of sulpharsphenamine.

8. It is believed that sulpharsphenamine has earned a well-merited place in the treatment of lues, and it should have a greater general use.

## TREATMENT OF SYPHILIS

By I. B. BALLENGER, Lieutenant (Junior Grade), Medical Corps, United States Navy

There is an outline of antisyphilitic treatment, serving as a guide to the routine treatment of syphilis, which is being used by several of the ships of the Asiatic Fleet. The U. S. S. *Huron* received 3,000 copies of this outline in 1925, and a number of these copies are now on the U. S. S. *Guam*. Most of the syphilitic abstracts on the *Guam* show treatment in accordance with this outline.

The outline for treatment consists of three courses, each course consisting of eight intravenous injections of neoarsphenamine and 10 intramuscular injections of mercury (succinimide or salicylate of mercury). The dosage of neoarsphenamine is as follows: First course: First week, 0.30 gram; second week, 0.45 gram; third week, 0.60 gram; fourth week, 0.75 gram; and thereafter four injections of 0.90 gram at weekly intervals. Second course: Thirteenth week, 0.30 gram; fourteenth week, 0.60 gram; fifteenth week, 0.60 gram; sixteenth week, 0.75 gram; and thereafter four injections of 0.90 gram at weekly intervals. Third course: Twenty-ninth week, 0.30 gram; thirtieth week, 0.45 gram; thirty-first week, 0.60 gram; and thereafter five injections of 0.90 gram at weekly intervals.

The dosage of mercury is not given in the outline, but each of the three courses consists of 10 injections at weekly intervals—beginning the mercury at the time of beginning the neoarsphenamine.

Notes appended to the outline base the extent of the treatment on the blood serum reaction, stating, "If at end of year Wassermann reaction is negative, stop treatment; if positive, give one more course of treatment as outlined in first course." The blood serum reaction is then taken at intervals of three months and treatment is advised up until the end of the second year only if the blood serum reaction becomes positive. At the end of the second year, treatment is discontinued if the blood serum reaction is negative.

Granting that the treatment of syphilis in the Navy must be routine treatment to a considerable extent, is one justified in using the outline of treatment given above? For the following reasons this does not seem to be a logical outline to follow:

1. The maximum dose of neoarsphenamine (0.90 gram) is not given until the fifth week.
2. After the eighth week eight weeks elapse before 0.90 gram of neoarsphenamine is given, making only four 0.90-gram injections before the seventeenth week of treatment.
3. The patient at the end of the third course of treatment goes 14½ months without treatment if the blood serum reaction remains negative.

4. Many syphilographers advise that we give as many as 10 to 12 doses of 0.90 gram nearsphenamine in a course.

Since it is accepted that arsenic (either as arsphenamine, sulpharsphenamine, or nearsphenamine) is by far the most valuable drug in the treatment of early syphilis and that the blood serum reaction should not be an absolute index to treatment, it would appear advisable to give intensive treatment as early as possible after diagnosis, provided proper precautions are taken in regard to the toxicity of the drug used.

The intensive treatment of early syphilis used to-day by many syphilographers who give 0.20 gram of nearsphenamine the first, 0.30 gram the fourth, 0.40 the seventh, 0.50 gram the tenth, and 0.60 gram the fifteenth day, with 0.90 gram at weekly intervals thereafter until 8 to 10 0.90 gram doses have been given, appears to be the most logical routine during the first course in the average case.

Although opinions differ in regard to a period of rest, the consensus of opinion seems to be in favor of a two months' cessation of treatment between the first and second and the second and third courses with a three months' period of rest between the remaining courses.

The diagnosis of syphilis having been established, the patient should be treated at least for three years and thereafter observed with quarterly Kahn tests and a minimum of two Kahn tests on the spinal fluid.

Too many enlisted men have been allowed to believe that their treatment will end at completion of three courses and that the Kahn test is an absolute index to their need of treatment. They therefore object when asked to take more than three courses of 8 or 10 injections.

As it is frequently found that only a notation of the number of arsenic and mercury injections is given in the syphilitic abstract without any record of the dosage or other necessary data on the medical history sheet, it is impossible to know how much mercury has been given. However, since many syphilographers give mercury in association with arsenicals with excellent results there is no reason why intramuscular injections (mercury salicylate, grains 1 to 1½) at weekly intervals should not accompany each course of arsenicals, with 10 to 12 injections making one course. Mercury injections in sufficient number are claimed by some authorities to be just as efficacious as intramuscular injections.

Intramuscular injections of bismuth, although not tested by long use, now appear to rank equally with mercury, if not in early syphilis, at least in the treatment of late syphilis or syphilis resisting mercury and arsenic.

Some authorities use none of the arsenicals except sulpharsphenamine and report excellent results and claim for this drug unusual value in the prevention and treatment of cerebrospinal syphilis. At the naval hospital, Philadelphia, intensive treatment with sulpharsphenamine, potassium iodide, and mercury inunctions has been in vogue, and has given excellent results.

Potassium iodide is not being used in the Asiatic Fleet as extensively as its time-proven value appears to merit.

The incidence of Kahn-positive spinal fluids in secondary syphilis has been given at 30–35 per cent and the incidence in tertiary syphilis at 70–80 per cent.

Antisyphilitic treatment must be carried on more or less in the dark, and very frequently we treat cases with a complete absence of any lighthouses to guide the way. Many cases of syphilis, when intensive treatment is begun on finding successive positive dark fields, with or without a positive Kahn test, are properly treated for three years even though repeated Kahn tests made after each rest period are negative. One course of treatment in some cases will produce a negative Kahn test which may remain negative for two or three years even if no more treatment is given, and the patient may or may not be cured.

The importance of arsenicals in the treatment of early syphilis is emphasized by the far greater number of reinfections that have been noted since the advent of arsenicals in the treatment of syphilis.

When it is more generally realized that the treatment and observation of a case of syphilis will take five years with three years of intensive treatment, then the incidence of syphilis of the cardiovascular and central nervous system which is now so common should be materially decreased.

## CLINICAL NOTES

### REPORT OF TWO HUNDRED EXAMINATIONS FOR ACUTE ALCOHOLISM MADE AT THE UNITED STATES NAVAL HOSPITAL, NEW YORK, N. Y.

By F. S. JOHNSON, Lieutenant Commander, Medical Corps, United States Navy

The term "drunkenness" is an implication of unfitness. An early recorded indictment occurred 337 B. C., when Alexander, blind with rage and jealousy, hurled his cup at the drunken Attalus.

"Macedonians," he said, "see there the general who would go from Europe to Asia! Why, he can not get from one table to another!"

To say that an individual is drunk is, however, often merely an expression of opinion. To attribute the condition of a person to alcoholic intoxication and later find his death to be the result of an organic lesion is a "tragedy" of errors fatal to the patient and very destructive of professional prestige.

Until recently no test has been readily available which might indicate the degree of intoxication of a stuporous patient with an alcoholic breath.

In August, 1928, Bogen published, in the *American Journal of Medical Sciences*, an article on drunkenness, for which he was awarded the Alvarenga prize for 1927 by the College of Physicians of Philadelphia. The paper was essentially a quantitative study of acute alcoholic intoxication, in which for the first time a test to determine the degree of intoxication was made feasible for clinical application.

Soon after the publication of Bogen's work this hospital undertook a similar study, using Bogen's colorimetric method of technic. While the figures given by Bogen were based almost entirely upon examination of the urine for alcohol, at this hospital it was thought that the analytical determination of the alcoholic concentration in the blood would have a greater significance.

As the examination of people under the influence of alcohol proceeded, it soon became apparent that the condition of the traditional "dead drunk" was invariably associated with 4 milligrams of alcohol per cubic centimeter of blood. Hence, this figure was taken as an expression of 100 per cent intoxication. The blood examination seemed preferable in view of the fact that urine was sometimes obtainable only by catheterization, a procedure which was not deemed advisable under the circumstances. Moreover, in instances when the

urine has not been voided for some time the existing condition of the patient at the time of examination is not accurately recorded by the urinalysis method.

It is assumed that a detailed discussion of technic here would be superfluous, inasmuch as this is fully described in Bogen's original publication. Suffice it to say that 1 cubic centimeter of oxalated blood mixed with 1 cubic centimeter of Scott Wilson's reagent is examined by the same technic as that employed by Bogen for urine. Scott Wilson's reagent should always be added to the specimen prior to examination, because alcoholism is frequently associated with ketogenesis.

For those not having ready access to Bogen's paper, the technic for blood examination is epitomized in the footnote.<sup>1</sup>

Any reducing substance, glucose, for instance, when added directly to the reagent employed will produce a reaction identical with that produced by alcohol. However, if the test is performed as directed and the air current adjusted so as not to carry over liquid containing the reducing reagent, the test can be considered specific for alcohol in body fluids.

A recent case in a state of coma supposedly due to alcohol has been observed. The Bogen test employed with blood was negative; the urine gave a positive reaction. That produced a puzzling picture. It was found that a small amount of liquid containing a reducing substance was being carried from the urine into the reagent by a too rapid air current. Upon proper adjustment of the air current the urine reaction became negative. The patient was found in possession of a 5-grain veronal tablet. Veronal was recovered from the patient's urine. He later confessed to having taken a large quantity of veronal. This incident is related in order to illustrate a possible source of technical error and to provide an example of a readily applied method in differential diagnosis.

It has been said previously that the state of the traditional "dead drunk" has been always associated with an alcoholic concentration of 4 milligrams per cubic centimeter of blood. It has become the custom at this hospital to make a laboratory report in such instances read "100 per cent intoxication." Accordingly, the detections of lesser amounts are reported in terms of the percentage of 4. For instance, the recovery of 2 milligrams of alcohol from 1 cubic centimeter of blood is reported as 50 per cent intoxication.

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<sup>1</sup> One cubic centimeter of oxalated blood is placed in a test tube containing 1 cubic centimeter of Scott Wilson's alkaline mercuric cyanid reagent, and a current of air bubbled through it at a moderate rate, and then passed through 5 cubic centimeters of the reagent mixture of one-third of 1 per cent potassium dichromate in 50 per cent sulphuric acid, for 10 minutes, both tubes being immersed in a boiling-water bath. The color changes are compared with known standards containing 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, and 4 milligrams of alcohol, respectively, in 5 cubic centimeters of the mixed reagent.



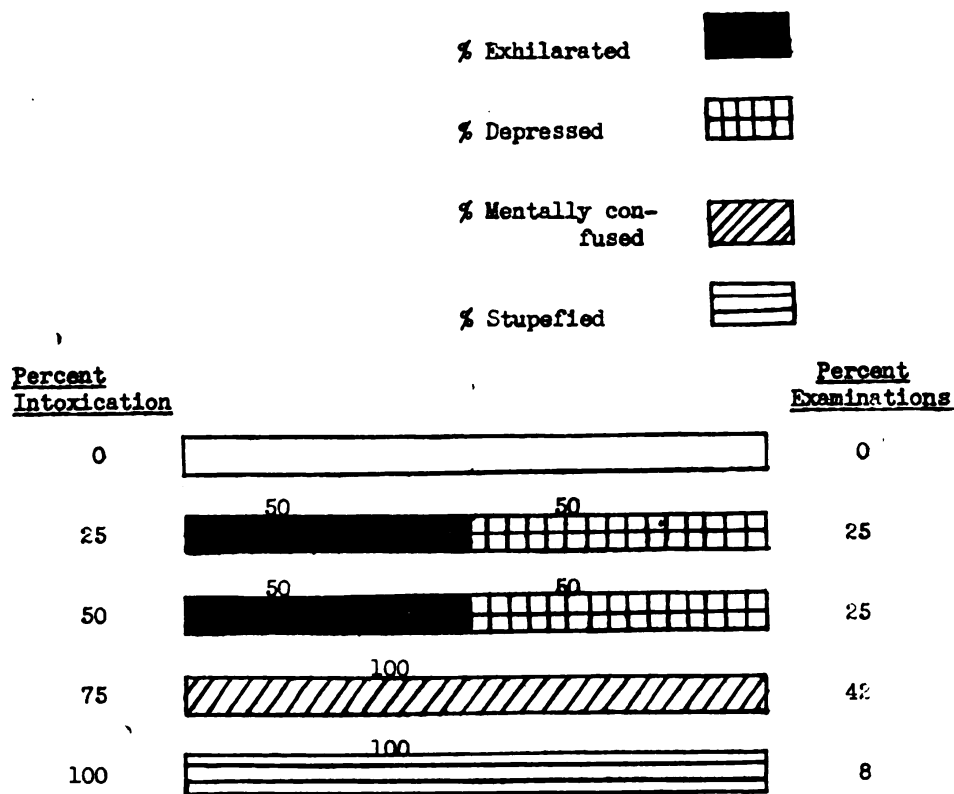
One may judge that a laboratory report specifying a definite degree of intoxication is open to serious criticism. However, it is the consensus of opinion among the medical officers comprising the staff at this hospital that these laboratory findings have been in practical accord with the clinical picture of the patient.

The report of a definite percentage of intoxication is significant. Everyone is aware of the apparent differences in susceptibility to the influence of alcohol among individuals and of the apparent variable degree of susceptibility in the same individual at different times. Undoubtedly there are variations in the absorption rate of alcohol from the gastrointestinal tract in the same and different individuals, as well as a tolerance variation. However, while it would seem that differences in proclivity to intoxication are both apparent and real, experience would indicate that the determination of the actual concentration of alcohol in the blood, and hence the alcoholic concentration affecting the tissues is an exact means of expressing the degree of intoxication at any time. The amount of alcohol consumed is as irrelevant as the amount of carbohydrate taken by a diabetic. Of prime importance is the ability of the individual to oxidize the alcohol consumed. All data imply that a person is quantitatively drunk in proportion to the concentration of alcohol in the blood.

Because it is very pertinent to the subject, the following case report is given in abstract form:

J. M. J., seaman second class, United States Navy, was admitted to ward F-2 at about 5.30 p. m., April 28, 1929. The patient had been picked up in the Greenpoint section of Brooklyn by a taxicab driver at about 5.15 p. m. and brought into this hospital. Examination showed a young man about 20 years of age, dressed in a sailor's uniform and in a state of coma from which he could not be aroused. There was a strong odor of alcohol in the breath. The pupils were widely dilated and reacted sluggishly to light. The reflexes were slightly exaggerated. There appeared to be a slight spasticity of the left arm. There was a small lacerated area in the region of the occiput. The temperature was 102° F. The pulse was 120. The blood pressure was 135/70. About one-half hour after admission the patient was able to talk and gave his name and address. About 7 p. m. he again lapsed into coma and could not be aroused. Shortly after this time he vomited about 1,500 cubic centimeters of liquid that smelled strongly of alcohol. It became of prime importance to know how great a factor alcohol was in the maintenance of coma. A chemical examination of the blood showed 1 milligram of alcohol per cubic centimeter, which indicated only a very slight degree of intoxication. At 11 p. m. the respirations were stertorous; the pupils were unequal and fixed; spasticity of the left arm was clearly apparent; there was loss of sphincter (urinary) control; the blood pressure was 170/40; pulse rate was 90; temperature was 102° F. A sub-temporal decompression operation showed the dura under marked increased tension and subdural blood clots covering the entire right cerebral hemisphere. No bleeding point or fracture could be found. The temperature, pulse, and respiration rapidly increased, the temperature reaching 108° F., and the patient died at 5.20 a. m., April 29, 1929. The autopsy revealed a fracture at the base of the skull and a laceration of the right occipital sinus.

The accompanying statistical table, based upon behavior reactions to varying degrees of alcoholic intoxication, graphically illustrates the psychic effect in different percentages of intoxication as observed in 200 examinations for alcoholemia. The percentages of patients showing exhilaration, depression, confusion, and stupor are indicated by shaded lines; to the left of these lines are expressed degrees of intoxication in terms of per cent, and to the right are listed the corresponding percentages of patients examined. Thus, all patients showing 100 per cent intoxication were stupefied; all showing 75 per cent intoxication were mentally confused; symptoms of either



exhilaration or depression were evenly distributed in those who were either 25 per cent or 50 per cent intoxicated, the only difference being in degree.

**HEART CLINIC, UNITED STATES NAVAL HOSPITAL, NORFOLK, VA., WITH REPORT OF SELECTED CASES**

By R. F. JONES, Commander, Medical Corps, United States Navy, and C. W. BRUNSON, Lieutenant, Medical Corps, United States Navy

Since there has been so much confusion in the nomenclature of cardiac diseases, before presenting a study of heart cases occurring at the United States Naval Hospital, Norfolk, Va., from January, 1927, to January, 1929, it might be well to consider the methods of

arriving at a diagnosis as used at that hospital, for it has been our experience in visiting several heart clinics in various parts of the United States to find different diagnostic terms frequently used for the same disease, even though each clinician had the same idea as to etiology, pathology, etc. Within a comparatively recent period a concerted effort has been made by the American Heart Association to bring about uniformity in diagnosis of cardiac diseases. This necessitates two things—first, uniformity of nomenclature; and, second, uniform criteria for using the nomenclature. It is obviously impossible in a paper, which has for its main purpose a review of the heart clinic at the naval hospital, to present in detail the nomenclature of the American Heart Association or the criteria for each diagnosis as recently published—September, 1928—by the New York Tuberculosis and Heart Association. Suffice it to say that in selecting case reports for this paper from the files of this hospital we have rejected all cases where data were insufficient to meet the requirements of the above associations. Altogether 280 case papers were reviewed.

In order that the reader may have a cross section of the heart clinic of the Norfolk Naval Hospital a statistical study has been made of 177 selected cases. There must necessarily be some overlapping in diagnosis, especially the etiological, as some of the case reports indicate that there might have been more than one cause for the disease; for example, when a patient gave a history of influenza, pneumonia, and gonococcus infection, it is impossible in reviewing the history to determine which is the etiological factor. Therefore in such cases we have tabulated all the causes. However, where a case report showed a definite history of rheumatic fever or syphilis, such disease was enumerated as its cause. So, too, with the anatomical and physiological diagnosis there is some overenumeration, as certain patients may have more than one entity. From this it is obvious that it is impossible to arrange this study on an accurate percentage basis.

TABLE I.—*Etiological diagnosis*

Unknown .....	4	Bacterial infection:	
Rheumatic fever:		Tuberculosis .....	2
Polyarthritis .....	47	Influenza .....	6
Chorea .....	2	Meningitis .....	1
Tonsillitis .....	31	Focal infection, teeth <sup>1</sup> .....	6
Syphilis:		Focal infection, prostate <sup>1</sup> .....	1
Active .....	36	Gonococcus infection .....	3
Inactive .....	2	Pneumonia .....	4

<sup>1</sup>The diagnosis of focal infection, teeth, is not entirely acceptable to the American Heart Association, but is put in the doubtful column as the cause of heart disease. This is also true of the diagnosis of focal infection, prostate.

Bacterial infection—Continued.		Hyperthyroidism .....	5
Scarlet fever.....	1	Arteriosclerosis.....	21
Diphtheria.....	2	Nephritis.....	19
Typhoid fever.....	2	Neurosis.....	8
Septicaemia.....	3	Trauma.....	1

TABLE II.—*Anatomical diagnosis*

Enlargement of the heart.....	112	Aortic insufficiency.....	26
Dilatation of the heart.....	1	Aortic stenosis.....	1
Ventricular preponderance:		Mitro insufficiency.....	57
Right.....	18	Mitro stenosis.....	41
Left.....	50	Pericarditis, acute serofibrinous..	3
Auricular hypertrophy.....	36	Aortitis.....	14
Myocarditis, acute.....	1	Aneurysm aortic arch.....	3
Myocarditis, chronic.....	76	Arteriosclerosis.....	21
Endocarditis, acute.....	4	Coronary occlusion.....	5

TABLE III.—*Physiological diagnosis*

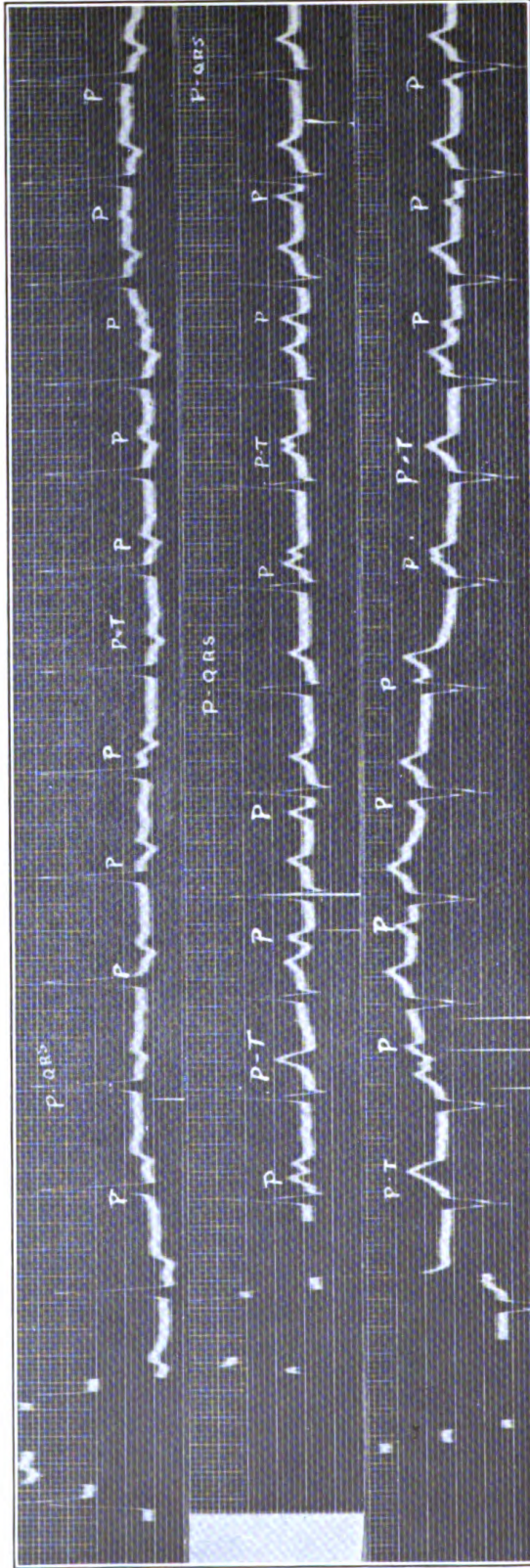
Regular sinus rhythm.....	91	Auriculoventricular heartblock:	
Vagal arrhythmia, sinus arrhythmia .....	13	(a) Partial block—	
Simple bradycardia.....	1	1. Prolonged conduction	
Ventricular escape.....	1	time.....	4
Wandering pacemaker.....	1	2. Occasional dropped	
Sinus tachycardia (not paroxysmal) .....	32	beats.....	2
Premature contractions:		3. High-grade block (2-1,	
Auricular.....	11	3-1, etc.).....	1
Ventricular.....	29	(b) Complete block.....	1
Paroxysmal tachycardia, auricular .....	3	Intraventricular block, bundle-	
Auricular fibrillation:		branch, right or left.....	7
Paroxysmal.....	1	Hypertension.....	39
Chronic.....	10	Effort syndrome.....	7
		Anginal syndrome.....	5

TABLE IV.—*Functional capacity*

Patients with organic heart disease, able to carry on ordinary physical activity without discomfort.....	53
Patients with organic heart disease, unable to carry on ordinary physical activity without discomfort:	
(a) Activity slightly limited.....	68
(b) Activity greatly limited.....	31
Patients with organic heart disease and with symptoms or signs of heart failure when at rest, unable to carry on any physical activity without discomfort.....	17
Deaths.....	8

There were two very rare and outstanding cases noted in this statistical study. Since there were several unusual features in each case, they are presented in detail.





(Jones and Brunson)

FIGURE 1.—P. P ROUTINE TRACING. LEADS 1, 2, AND

91-1

## CASE 1

P. P., admitted to United States naval hospital, Norfolk, Va., December 15, 1927, from United States naval station, Guantanamo Bay, Cuba.

*Etiological diagnosis.*—Unknown; possibly tonsillitis.

*Anatomical diagnosis.*—Myocarditis.

*Physiological diagnosis.*—Complete heart block; intraventricular heart block.

*Functional capacity.*—Able to carry on regular duties.

*Chief complaint.*—Irregularity of pulse.

*Present illness.*—First admitted to sick list complaining of precordial pain, on October 1, 1927, at naval station, Guantanamo; this pain varied as to character, at times dull, then sharp. It never lasted more than a second or two. Pain was sufficiently severe to incapacitate him, but not constant in any particular region of the precordium. The fleeting pains as described by this patient continued for about a week, at which time he was absolutely free from other symptoms. There has been no recurrence of the precordial pain since that time.

*Family history.*—Essentially negative.

*Past history.*—Essentially negative except for acute catarrhal fever, which occurred about a month prior to the present illness. There is no history of rheumatic fever, tonsillitis, or syphilis.

*Physical examination.*—White male, about 23, Italian by birth. General appearance: Height, 65½ inches; weight, 131 pounds. Patient apparently in no discomfort. Head, eyes, ears, nose, and throat essentially negative. Neck: No pulsation. Heart: Rate, 106; rhythm irregular; force somewhat irregular. Size of heart and arch of aorta within normal limits. There is a soft systolic murmur heard at the base which is believed to be cardio-respiratory. A, louder than P. After exercise the pulse was 140 and arrhythmia was increased. Two minutes after exercise, rate had returned to 106 and pulse continued to be irregular. There was no pulse deficit. The blood pressure was 140 systolic for the strongest beats, all beats come through at 128. Diastolic, 78. Abdomen and extremities: Negative. Neurological: Negative.

*Laboratory and special reports.*—Orthocardiogram: Heart normal in size. Complete blood picture; normal. Kahn: Negative. Urine: Negative. Tonsils were found to be chronically infected. Patient refused tonsillectomy.

*Electrocardiographic reports.*—Figure 1: Leads 1, 2, and 3, taken shortly after admission, shows an auricular rate of 70 with a ventricular rate of 80, both of which have basically a regular rhythm but seem to be independent. It is noted that the P waves vary in their relationship to the QRS complex, gradually approaching the complex, then becoming superimposed within it, and later falling behind it; the P wave is then superimposed on T and still later again approaches the QRS complex. This was noted in all routine tracings.

The QRS complex shows a slight slurring of the descending limb of R in leads 1 and 2, with a definite slurring of both limbs of S in lead 3. T is inverted in lead 1 and upright in leads 2 and 3, which is opposite to the QRS complex in leads 1 and 3.

The following opinion was given on the above findings:

1. Complete heart block with ventricular rate faster than the auricular rate.

Since there is slurring of QRS complex in all three leads, and T is opposite to the greatest QRS deflection in leads 1 and 3, there is also a right bundle branch block.

Numerous other tracings were made before and after exercise and atropine. The tracings before exercise continued to show the same findings as noted in Figure 1, while exercise and atropine made a radical change.

Figure 2: Tracing (a) is lead 2, which was made two minutes after exercise. This shows both a ventricular and auricular rate of 120, each P falling on T with a prolonged P-R interval, although it can not be measured accurately. Tracing (b) is lead 2, made six minutes after exercise, which shows practically the same thing as (a) except that the rate is slower (95), and the P-R interval appears to be longer. Tracing (c) is lead 2, made shortly after one-fiftieth grain of atropine was administered to the patient and shows a normal auricular ventricular rhythm with a prolonged P-R interval of 0.40 second. Tracing (d) is lead 2, made just before patient was discharged from the hospital, after four months' treatment without any apparent change from the independent auricular and ventricular rate shown in Figure 1.

*Progress notes.*—December 22, 1927, the irregularities have disappeared. Patient feels very well, no cardiac distress. One month later patient showed no signs or symptoms of heart disease other than that found by the electrocardiographic tracings. One month later, February 20, 1928, there was no change in the patient's general condition, and on March 1, 1928, he was discharged from the naval service by reason of medical survey.

This case is thought to be interesting, first, because of the complete dissociation of auricular and ventricular rhythm with the ventricular rate the fastest; second, improvement of conduction after exercise and atropine and the resumption of the sinuauricular node as the pacemaker for the auricle and ventricle after exercise, then after rest the recurrence of complete dissociation of the auricular and the ventricular beats; third, the absence of symptoms even after strenuous exercise; fourth, absence of physical findings other than irregular pulse; fifth, no definite etiology; sixth, the youth of the patient.

#### CASE 2

J. S., admitted to the naval hospital, Norfolk, Va., May 16, 1927, from the naval air station, Hampton Roads, Va.

*Etiological diagnosis.*—Typhoid fever.

*Anatomical diagnosis.*—Myocarditis. No enlargement of the heart.

*Physiological diagnosis.*—Paroxysmal tachycardia.

*Functional capacity.*—Limited to light work.

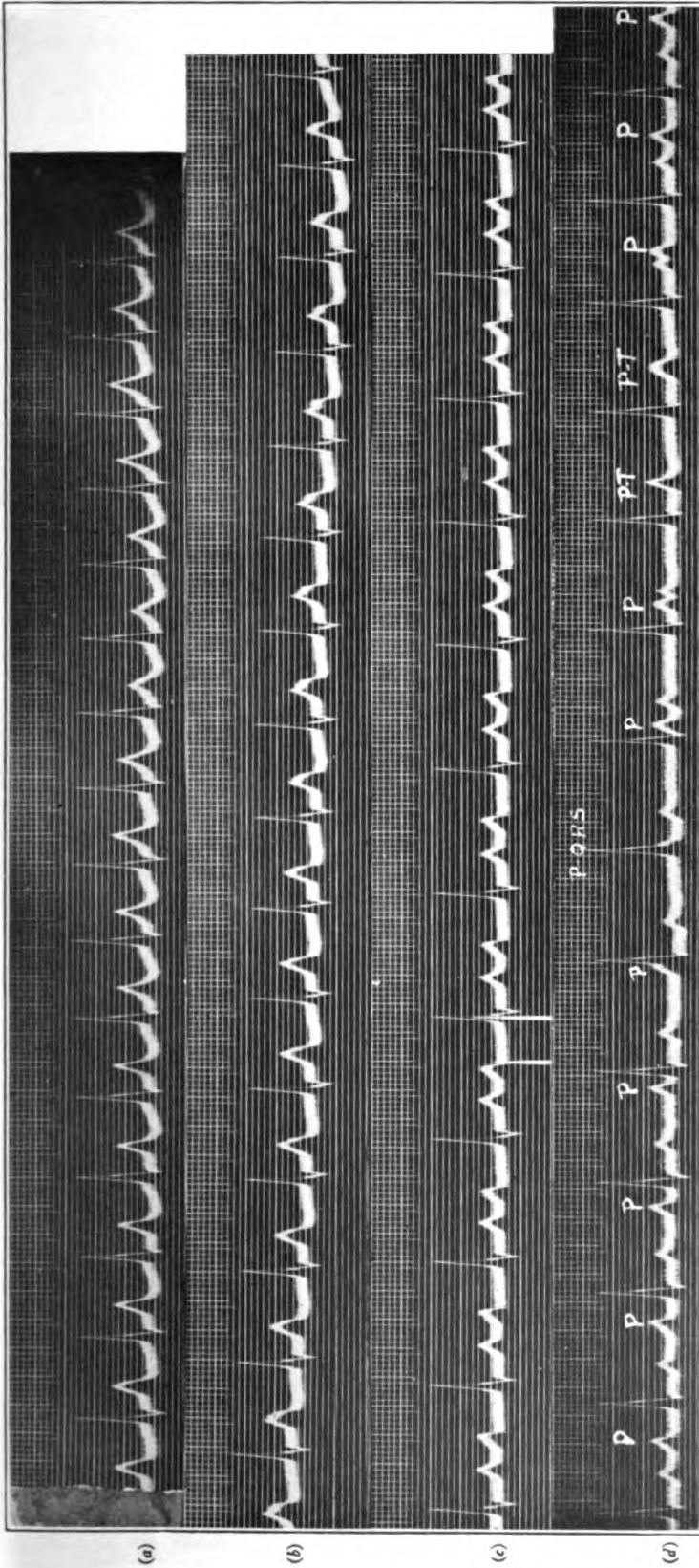
*Chief complaint.*—Palpitation of the heart, and syncope.

*Family history.*—Essentially negative.

*Past history.*—Negative except for tropical fever of typhoidal character which, at the age of 22, lasted for one month, and from which he suffered three attacks of paroxysmal tachycardia during convalescence. Denies venereal disease. Tonsillectomy in 1926. No rheumatic fever or chorea.

*Present illness.*—In 1921, following a long aviation flight, but without obvious cause, he developed a paroxysm of rapid heart action, later losing consciousness for a few seconds. Up until 1922 he had an occasional such attack, but since then the frequency of the attacks have increased. The attacks are more fre-





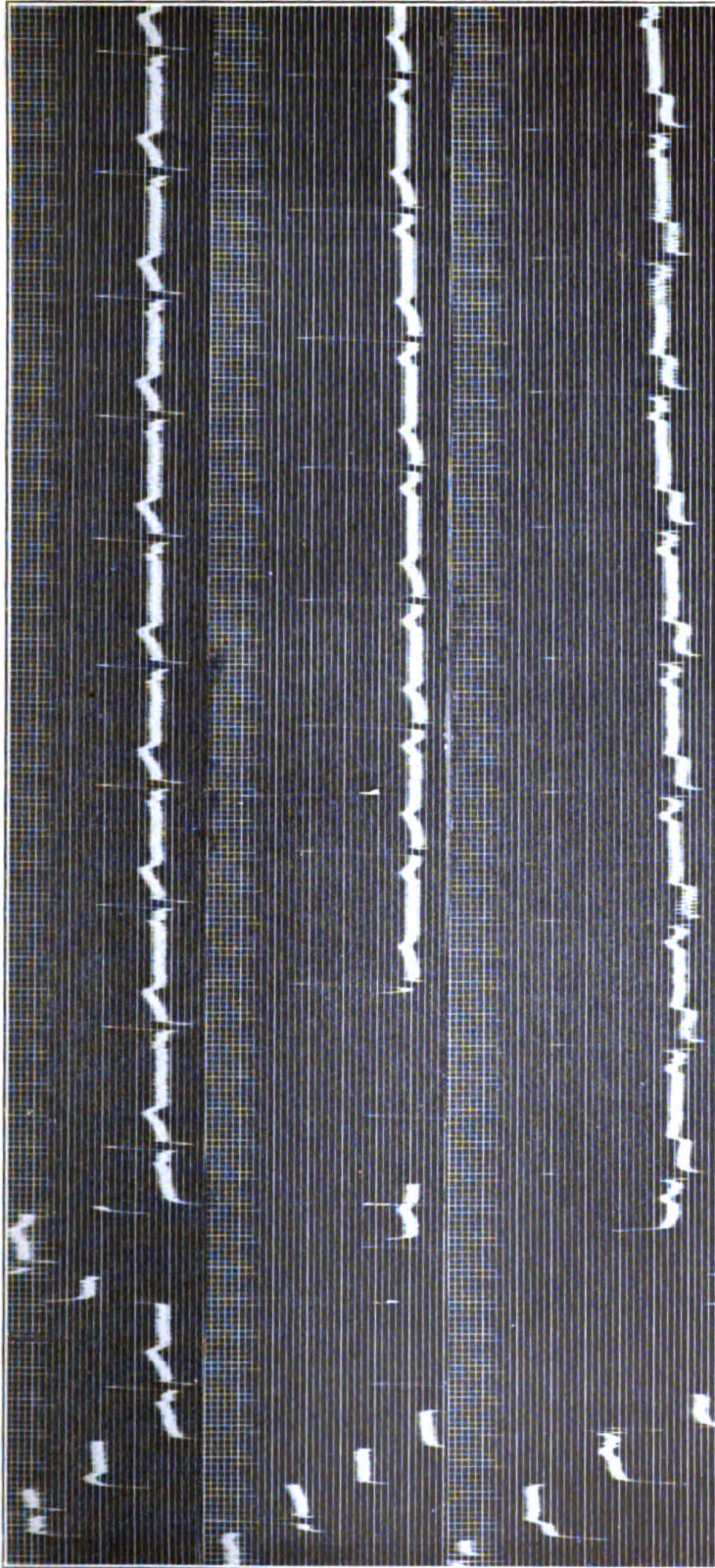
(Jones and Brunson)

FIGURE 2.—P. P. TRACINGS FROM LEAD 2

- (a) TWO MINUTES AFTER EXERCISE.
- (b) SIX MINUTES AFTER EXERCISE.
- (c) AFTER ATROPINE.
- (d) PRIOR TO DISCHARGE.

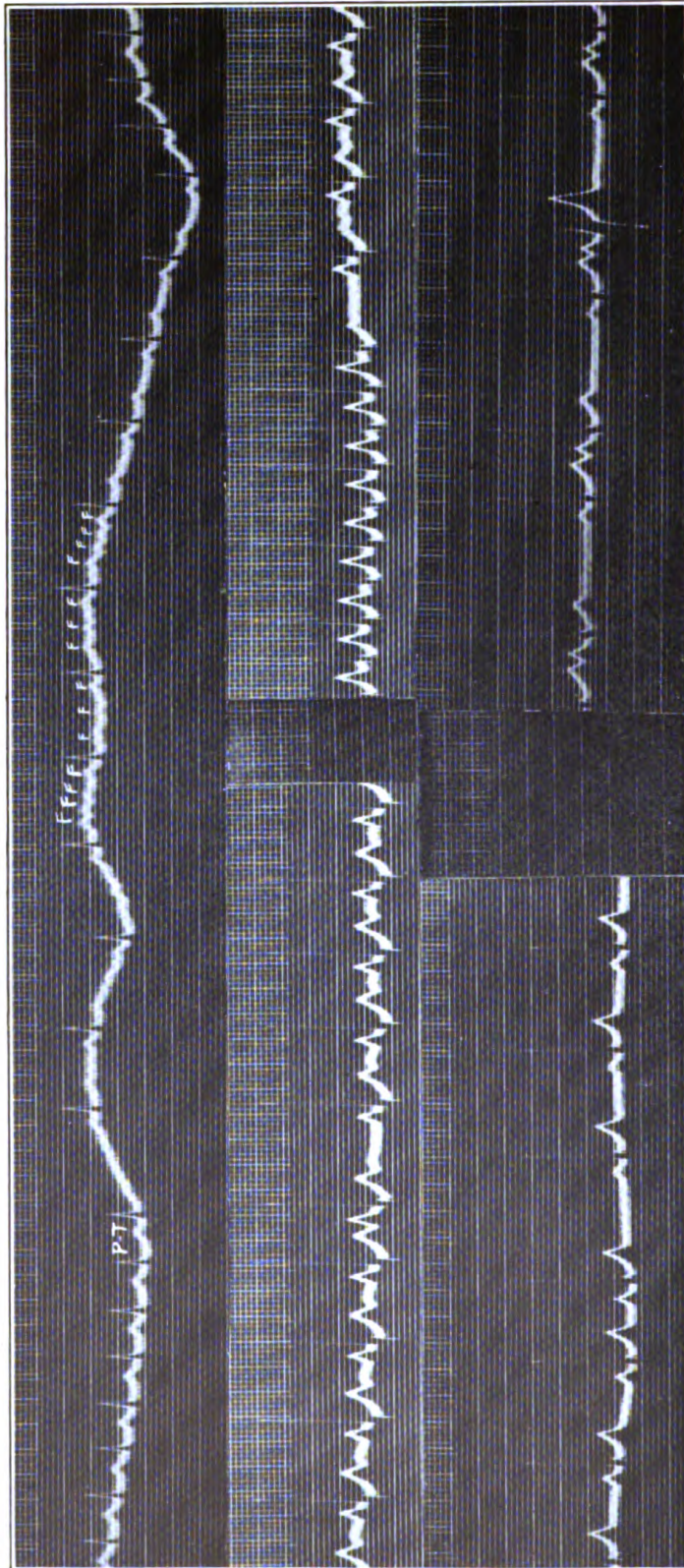
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(Jones and Brunson)

FIGURE 3.—J. S. ROUTINE TRACING. MAY 18, 1927. LEADS I, 2, AND 3



(Jones and Brunson)

FIGURE 4.—J. S. VARIOUS FINDINGS SELECTED AT RANDOM

quent when the patient is working hard, but they have occurred when at rest. Patient has been unable to correlate any definite causes for these attacks. The heart may be beating regularly when an irregular rhythm develops. This is attended by subjective distress. The patient has sufficient reserve to get about. While the irregular rhythm is present, suddenly within one cycle a very rapid heart rate may be attained. He states that he occasionally loses consciousness but does not fall. He will drop anything he is holding or will pause in conversation. He states that he feels that he might fall, so he always supports himself. These attacks of syncope last for only a minute or two. Recently he has noted that the paroxysms of tachycardia at times will last from a half-hour to several days, but usually for only a few seconds or minutes. He has noticed that his mental powers are much impaired during such attacks. There has been no congestive failure or dyspnoea.

His record shows that he has been on the sick list much of the time during the past five years, during which time he was a patient at naval hospitals, San Diego and Washington. He was given digitalis, diuretin, quinidine, quinine, and atropine while at these hospitals. According to his own statements, the best results have been obtained from digitalis. Reports obtained from other hospitals show that at times there have been discovered in the electrocardiographic tracings auricular fibrillation, but in most instances only paroxysmal tachycardia.

*Physical examination.*—Well developed and nourished white male, 35 years of age. Head and neck negative. Thorax: Expansion good and equal. Lungs: Negative. Heart: Outlines not enlarged, short systolic murmur heard only when erect over the apex. Frequent extra systole is noticed both on auscultation and in the pulse. The blood pressure was 120/80. The abdomen was negative. Genitalia: Negative. Anal region: Small hemorrhoids. Skin: Numerous scars of old lacerations about face. Mental examination shows slight retardation and some blunting of acuteness of perception.

*Laboratory findings.*—Kahn: Negative. Blood picture: Normal. Urine: Normal. Blood chemistry: Normal.

Figure 3: Leads 1, 2, and 3 are tracings taken on admission and show a normal rate and rhythm, the only abnormality being a diphasic T in lead 3.

Numerous tracings were made on this patient over a space of several months and the different findings were quite varied and interesting; practically every type of arrhythmia was shown at one time or another, and in several tracings which were taken for several minutes would show three and four different rhythms. Figures 4 and 5 are sections of longer tracing of lead 2, which are used in attempting to show the different rhythms that were found at different times.

Figure 4: Tracing (a) shows a paroxysmal auricular tachycardia of a rate of 180, which ceases suddenly, followed by a long pause, then regular rhythm for three cycles; then the rhythm becomes what appears to be auricular flutter (FFFFF), with an auricular rate of about 340. The ventricular rhythm remaining regular, the latter part of this tracing again shows paroxysmal auricular tachycardia.

Tracing (b) shows one auricular premature beat followed by a compensatory pause, the latter part of which shows a very rapid paroxysmal auricular tachycardia.

Tracing (c) shows two auricular premature beats; the second auricular premature beat is followed by an aberrant ventricular response and the latter part of the tracing shows a bigeminy from auricular premature beats.

Figure 5: Tracing (a) shows a bigeminy of a normal complex followed by a ventricular premature beat, with the normal P falling at X in the premature beat.

(b) is another section of a tracing showing auricular paroxysmal tachycardia.

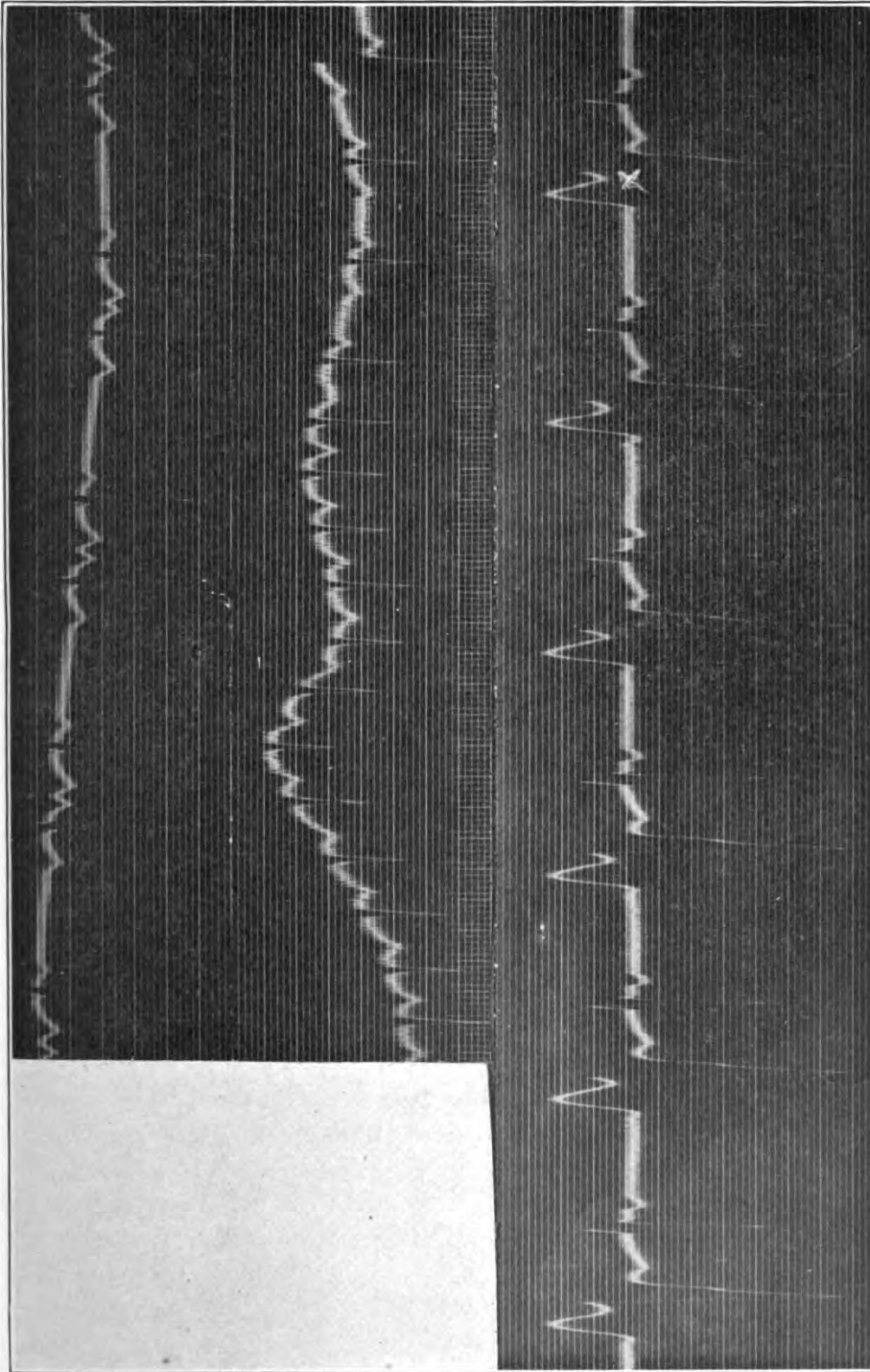
Tracing (c) shows a bigeminy but different from tracing (a) in that the normal complex is followed by an auricular premature beat.

Summary of findings of the electrocardiographic tracings:

1. Normal tracing.
2. (A) Paroxysmal auricular tachycardia. (B) Auricular flutter.
3. (A) Auricular premature beats. (B) Ventricular premature beats.
4. (A) Bigeminy from auricular premature contractions. (B) Bigeminy from ventricular premature contractions.

*Progress notes.*—The patient was placed on quinine grains 3 and one-fortieth grain strychnine three times a day, and was kept on this for a period of three weeks without any result. Pressure over the vagus failed to bring relief. On June 10, 1927, digitalis was commenced; patient was completely digitalized, and then a maintenance dose of  $1\frac{1}{2}$  grains was continued. By June 16 patient was so much improved he was allowed to go home at night, although pulse continued to be irregular, there being many extra systoles and at times paroxysms. Digitalis continued until August 27. It was then discontinued, as there seemed to be no longer any improvement from its use as shown from physical examination and electrocardiographic tracings. Ten days after discontinuance of digitalis patient was put on quinidine grains 3 t. i. d. first day, second day quinidine grains 4 t. i. d. and quinidine grains 5 on the third day, and the dose gradually increased until he was receiving quinidine grains 9 t. i. d. This was continued for a period of about two weeks. Physical examinations and electrocardiographic tracings showed absolutely no improvement from quinidine therapy. On November 7 he was again put on digitalis; and, according to the patient's statement, seemed to be in a better condition as a result of this treatment than from any other treatment. He was finally discharged from the United States naval service with a diagnosis of myocarditis and paroxysmal tachycardia, there being but little improvement from treatment.

This case is particularly interesting since he had been under observation of civilian heart specialists and at the best hospitals of the Navy for a period of five or six years. He was most cooperative. While under treatment he informed us that the only drug that gave him any relief at all, and that very slight, was digitalis. Another feature which was of interest to us was the diagnosis—was this a case of paroxysmal tachycardia or was the paroxysmal tachycardia due to myocarditis? We felt that myocarditis was responsible inasmuch as in the frequent tracings we had there were ectopic auricular extra systoles as well as auricular extra systoles arising in or near the sino-auricular node. In addition, the electrocardiographic study was particularly interesting, as we never quite knew what the next tracing would show.



(Jones and Brunson)

FIGURE 5.—J. S. VARIOUS FINDINGS SELECTED AT RANDOM





**SOME CLINICAL TYPES OF FUNCTIONAL HEART DISEASE<sup>1</sup>**

By D. FERGUSON, Lieutenant Commander, Medical Corps, United States Navy

These cases which are being presented illustrate the proper and the improper method of handling a condition, the treatment of which, in the main, is eminently unsatisfactory.

(1) Mr. P is an American of Italian origin, 38 years of age. He enlisted in 1917; went overseas and saw active service. He had always been in perfect health until, following acute rheumatic fever in 1922, an aortic diastolic murmur was noted. He was given vocational training for a period of four years and his medical advisor cautioned him against overexertion and exposure. During this period he received \$160 compensation monthly from the Veterans' Bureau. Since his vocational training was discontinued, his compensation has varied considerably and he labors under constant strain and anxiety about his remuneration.

On physical examination he is well developed and well nourished. The heart is not enlarged to percussion or to X ray. An aortic diastolic murmur, without the peripheral signs of aortic regurgitation, is present. The electrocardiogram is normal and all laboratory tests (including those of the spinal fluid) are normal. The blood pressure is 130 over 70. The response to an exercise is most interesting. Objectively, the response is normal; subjectively, markedly abnormal. His constant complaint is precordial pain, weakness, palpitation, and dizziness. As a rule he feels better in the evening than in the morning. He has good days and bad days, getting around quite well and able to work on occasions, but at other times scarcely having the strength to get out of bed. There have never been any signs of decompensation.

This patient is shown to illustrate functional heart disease occurring concurrently with organic rheumatic aortic disease. His entire cardiac disability is due to the former condition. It is interesting to note that he got along excellently and was fairly happy and contented until his pension was greatly reduced, and he found it necessary to use the trade, at which he was playing, as a self-sustaining business.

We have studied this man thoroughly on several readmissions and believe he is not a malingerer. Our psychiatric service explains his cardiac pains, palpitations, and weakness in a very logical manner as a defense mechanism. They found a well marked anxiety neurosis, the psychic trauma element of which is how much or how little compensation he will receive each month.

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<sup>1</sup> A clinic given for the American College of Physicians, April 9, 1929, under the direction of Capt. F. L. Pleadwell, Medical Corps, U. S. Navy, and Capt. F. E. Sellers, Medical Corps, U. S. Navy, at the United States naval hospital, Chelsea, Mass.

This patient demonstrates the necessity for meticulous care in advising the organic cardiac with neuropathic tendencies. Unwarranted pessimism produces cardiac phobias, and though the fear inspired patient does live a few months longer, he suffers constantly and unnecessarily from the pains, palpitations, and weakness which a focused, apprehensive attention enlarges constantly.

(2) The second patient is Mr. M., a native-born American, age 42. He has had cardiac symptoms which developed during active service in the Army. After discharge from the service a nervous disability developed which has been thoroughly studied and explained to him. He had always been perfectly well prior to the war, but was unable to perform the duties of his former occupation as a railroad conductor following his discharge from the service. His cardiac symptoms are similar to those of the first patient presented.

On physical examination, no evidence of organic heart disease is elicited and the electrocardiogram, X-ray, and laboratory examinations are essentially normal. The response to a cardiac functional test is normal objectively and markedly abnormal subjectively. This patient is a partially deteriorated dementia præcox. He, too, has introspectively searched his body for some basis to explain his inadequacy and inability to make an economic adjustment. He is a real casualty of the war. He entered the service from the comparatively sedentary occupation of a railroad conductor. In France he was transferred from the railroad division to an outfit of pioneer engineers. As you will recall, the Engineer regiments of the Army have exceptionally high morale and the splendid manner in which they conducted themselves during the Byng offensive of December, 1917, set an extraordinary standard of accomplishment for subsequent regiments. Undoubtedly this patient's disability had its inception in the nervous and physical exhaustion which he incurred in attempting to live up to these high standards.

(3) The third patient is Mr. S, a naturalized American of Armenian origin, age 40. He entered the Army in 1918 from the sedentary occupation of a weaver. He experienced great difficulty in performing the drills, and finally, after three months of service, collapsed during a rather violent program of setting-up exercises. He was subsequently surveyed from the military service with organic heart disease. His constant complaint has been attacks of pain in the left breast. This pain is described as if the heart were being pressed upon as by a vise. This pain is precipitated by exertion; at other times it occurs while the patient is sitting quietly or resting, but it only occurs when the patient feels nervously depressed. It lasts but a few minutes and is not referred. It never follows exposure to cold. Its frequency, duration, and intensity have been un-

changed in the past 10 years. To obtain relief from this pain the patient always lies down. There has been no tendency to stand erect with the chest expanded. The pain has never been substernal.

On physical examination, the heart is not enlarged; the rhythm is regular; a functional pulmonic systolic murmur is heard; the blood pressure is normal, and the response to a cardiac functional test is abnormal subjectively, but objectively it is entirely normal.

This patient is presented as an effort syndrome precipitated by unaccustomed exertion in a physical inferior. The large anxiety element in this case is due to fear of a cardiac disaster instilled in his mind by pessimistic physicians who have communicated to the patient unwarranted concern over this unimportant murmur. While the chest pain has many features of angina pectoris, observation and study of this patient precludes such a diagnosis.

(4) The fourth patient is Mr. D, an American, aged 32, who entered the hospital for the first time about three months ago to convalesce from a mild lobar pneumonia. He requested to have his heart condition studied, stating that immediately after his discharge from the Army he suffered from palpitation, precordial pain, and weakness for a year. Finally in 1922 he consulted Dr. Paul White, who diagnosed the cardiac disability as an effort syndrome. Doctor White explained to the patient the condition and advised him to find work within his capacity. The patient has followed this advice and has been an entirely self-sustaining member of society, and although he has been unable to fulfill his educational and occupational ambitions, he gets along very well. The palpitations, the dizziness, weakness, and fainting spells have largely subsided.

On physical examination the heart is entirely normal. X ray of the heart is normal for size and shape; the electrocardiogram is not abnormal and the patient's response to a cardiac functional test is well within the normal limits objectively.

This patient is shown to demonstrate what can be accomplished in these cases by proper handling. Had he spent his days at the Veterans' Bureau attempting to get compensation and devoted his nights to introspective analysis of minor physiologic sensations, there is no doubt that he would present the same clinical and economic picture as the first three cases.

Although first described by DaCosta in 1864, our knowledge of effort syndrome really dates from the studies of the English cardiologists during the recent war. The definition of the English school is offered, that it is a symptom complex in which the symptoms and signs produced in normal subjects by excessive exercise appear following slight exertion, and no signs of structural heart disease are found. Regarding the etiology, constitutional inferiority, physical,

nervous, or both, is the outstanding feature. Chronic exhaustion, stress, and infection play only a minor rôle.

The incidence is surprising; it averages about 30 to 40 per cent of large series of cases presenting heart symptoms. The attempt has been made to divide functional heart disturbances into the effort syndrome or neurocirculatory asthenia group and the other group of the so-called cardiac neuroses. This distinction seems hardly necessary.

Cobb and White found the underlying neuroses in these functional disorders of the nervous system attended by cardiac symptoms to be (a) fatigue, (b) introspection, (c) anxiety, (d) substitution, (e) obsession.

As we see these recipients of Government pensions, they present an interesting study of ethics. While none of these pensioners view their remuneration in the light of alms or charity (which it certainly is not) the ultimate effect on their sense of self-respect is exactly the same as that of the professional beggar. Their ethical senses undergo atrophy. The sense of well-being following normal human accomplishment is not obtained by them. There are no visions of a happier, better future.

Where lies the remedy, admitting the Government's responsibility in helping discharged soldiers to adjust to the changed conditions of civil life? The remedy is to provide for all men with cardiac signs or symptoms examination and classification by a competent cardiologist. The average general surgeon or practitioner is not competent to pass on these cases. These patients with functional heart disease should be regarded from the standpoint that a neurosis is a true disability. It should be carefully explained to them that their heart symptoms, while in no way dangerous, may be (and probably will be) uncomfortable. The greatest benefit they can receive will come from the reassurance of the cardiologist. Medicine is entirely useless. These men may be given light calisthenics, and weakness, tachycardia, and syncope will result from a degree of effort which is less than the amount consumed by the patient's activities about the ward. In studying effort syndrome cases in an army hospital in France, P. D. White found that patients who were unable to perform the lightest calisthenics could, while playing ball, make a home run with only normal distress when they were intensely interested in the game. We have repeatedly confirmed this important observation.

In connection with the pain features of the syndrome, a practice of Dr. Richard C. Cabot is of great value. Doctor Cabot listens intently to the patient's description of his pain, its character and intensity. He then asks the patient if he would be greatly concerned about the pain if it occurred in some unimportant part of the body

(such as the arm or leg). It is surprising how often the reply is in the negative.

The prognosis for these cases is given by R. T. Grant, who analyzed 601 cases five years after they were classified by Lewis and his associates in the two military heart hospitals established by the British Army. He found that 15 per cent of the cases were entirely recovered, 18 per cent improved, 56 per cent stationary, 3 per cent worse, 8 per cent had developed serious disease, and 2 per cent were dead. This death rate was carefully examined and found to be no higher than that of the general population. An important finding is that among the 8 per cent developing serious disease, in almost half the disease was pulmonary tuberculosis. These figures were also carefully examined and the tuberculosis incidence was 80 per cent greater than that of the general population. A feature of Grant's study was his finding that actual malingering was rare, but that there was a common tendency to overemphasize the severity of the symptoms. He advances the interesting idea that the percentage of exaggeration in his series is balanced by the fact that many patients returning to civil life and former accustomed habits and occupation are rendered less sensible of their unfitness. These statistics are much better than the reports from the French and German sources. One French writer, analyzing 28 cases seven years after onset, found 20 of the cases unimproved or worse. A German, Jaquet, was so pessimistic over the neuropathic features that he suggests as the proper name for the syndrome "circulatory psychosis."

The figures for the United States service are debatable. Unfortunately, our hospital statistics do not give an accurate picture of the incidence of the disease, as the examining cardiologist for the local Veterans' Bureau is thoroughly familiar with the condition and handles this type of patient as an out-patient or soldiers' home case.

You gentlemen are well aware of the difficulties encountered in attempting to benefit these patients in the more ideal environment of civilian practice. Consider the incentive to retain symptoms and weaknesses and palpitations which compensation offers to the constitutionally inferior, who intuitively knows that the worse he feels the more he will get.

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#### THE USE OF HISTAMINE IN GASTRIC ANALYSIS<sup>1</sup>

By H. E. RAGLE, Lieutenant Commander, Medical Corps, United States Navy, and L. E. McDONALD, Lieutenant (Junior Grade), Medical Corps, United States Navy

During the past 10 years numerous workers have been striving for better methods of determining gastric function. The Ewald test meal showed too high a percentage of achylia, the use of meat extracts

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<sup>1</sup> From the Medical Service of the U. S. naval hospital, Mare Island, Calif.

was too confusing, and the results of psychic stimulation of the gastric secretion were not constant. All these methods took considerable time. The alcoholic method was a distinct advance and has been used by some of the larger clinics. In 1920 Keeton, Koch, and Luckhardt found that histamine had a marked effect in stimulating the gastric secretion in the dog. Carnot, Koslowski, and Libert then studied its effect upon human gastric secretion. Since this time numerous workers have studied its effect upon gastric secretion, using various methods, and have reported it as being more satisfactory than the alcoholic method.

Histamine (betaminazolyethylamine) acts directly upon the acid-secreting cells of the stomach. Carlson and Ivy have stated that it is the only positive stimulant of gastric secretion. It has proved to be a distinct advantage in differentiating organic achylia from functional achylia. The number of cases diagnosed organic achylia has been lessened by 20 per cent. In normal individuals Brancati found that the total acidity and the free acidity averaged 30° higher by the use of histamine than by the Ewald test meal; and in patients with ulcer he reports 20° to 40° higher acidity. In patients with gastric carcinoma, primary anemia, syphilis, advanced tuberculosis, hyperthyroidism, tabetic crises, and many wasting diseases the acidity is from anywhere below normal to zero.

The technique used in testing the gastric secretion in this hospital is as follows: The patient is put to bed and receives no food for at least 12 hours before the test is made. He is advised to refrain from taking anything by mouth in the morning before the test is made. A Rehfluss tube is passed into the stomach and the fasting contents withdrawn with a 50 cubic centimeter Luer syringe. Then 0.1 milligram of histamine per 10 kilograms of body weight is injected subcutaneously, and following this the stomach contents are aspirated at 5-minute intervals for the next 30 minutes, the position of the patient being frequently changed. The specimens of gastric contents both fasting and after histamine are measured and examined for total acidity and for free acidity. Total acidity and free acidity are estimated by titration with tenth normal sodium hydroxide, using as an indicator dimethylaminoazobenzene and phenolphthalein; the results are stated in terms of the number of cubic centimeters of tenth normal sodium hydroxide required to neutralize 100 cubic centimeters of gastric contents.

The histamine preparation used is a 1:1,000 solution of Burroughs, Wellcome & Co.'s ergamine acid phosphate. Following the subcutaneous injection there is usually a small wheal at the site of injection. In some instances there is a slight flushing of the face which lasts about one-half hour. There has never been any com-

plaint or untoward symptoms from the subcutaneous injections of histamine using the dosage mentioned above.

As a preliminary report, the results obtained by the use of histamine in 50 cases have been tabulated in the accompanying table, together with a brief summary of their histories. No choice of cases was made, but all were used in which there were symptoms referable to the gastrointestinal tract.

This series includes cases from 29 to 75 years of age. The amount and acidity of the gastric secretion normally varies with the age. The number of tests made for the various ages is not great enough to allow any definite classification to be made. A more or less arbitrary figure of 80° maximum and 70° minimum for total acidity has been used for normal in interpretation. Of course, there is an overlapping of the normal and the pathologic, and as is the case with most tests, a good history makes the final diagnosis. The conclusions in this series were made without reference to the history or X-ray findings.

Cases No. 19 and No. 24 clinically and by X ray showed no pathology in the gastrointestinal tract but had malignant tumors in the mediastinum. Their histamine tests showed a low acidity.

Case No. 31 was definitely one of Graves's disease and had a low acidity.

Case No. 27 was one of the few disagreements with the X-ray findings. This patient was operated upon for a gastric ulcer, but no organic lesions were found.

Case No. 48 is to be rechecked following antisyphilitic treatment.

In a few instances the patients had been on the Sippy treatment which might have caused a lower acidity.

Case No.	Age	Brief summary of history	Mils of secretion in 30 minutes	Free HCl	Total acid	X-ray findings	Conclusions
1	39	Dull pain in epigastrium for past 8 months following meals relieved by soda; some nausea; no vomiting; eructations of gas; slight tenderness in epigastrium; loss of 8 pounds weight.	18	16	32	Duodenum freely movable, filling defect in duodenum.	Histamine test indicates a possible malignancy.
2	29	Gnawing pain in pit of stomach coming on 3 to 4 hours after meals, relieved by soda. Treatment for ulcer 3 times in past 7 years; no significant physical findings.	33	120	136	There is a filling defect in the duodenum with adhesions. Conclusions, duodenal ulcer.	Histamine test indicates an ulcer.
3	30	History of pain in left chest more severe with respiration. No symptoms referable to the digestive tract. (Control.)	165	67	78	The X ray is negative for pathology.	Histamine test is normal; amount of secretion high.

Case No.	Age	Brief summary of history	Mills of secretion in 30 minutes	Free HCl	Total acid	X-ray findings	Conclusions
4	32	Burning pain in epigastrium occurring without relation to meals; it is relieved by soda; stomach feels better full; loss of 5 pounds weight in past year; there is slight tenderness in the epigastrium.	40	46	62	The gastrointestinal tract is negative.	The acidity is slightly low.
5	32	Pain in the pit of the abdomen occurring 1 to 2 hours after meals; pain is dull and gnawing in character; relieved by soda; vomits occasionally; there is slight tenderness in the epigastrium.	128	92	100	There is a filling defect in the duodenum. Conclusion, duodenal ulcer.	Histamine test suggests ulcer.
6	58	Uncomfortable feeling in the abdomen about 1 hour after meals; appearance of lump in epigastrium at times during past 2 years; loss of appetite and a great amount of weight; necropsy showed a large gastric carcinoma.	5	0	9	Large filling defect in media of stomach. Conclusion, carcinoma.	Histamine test indicates malignancy.
7	33	Distress in the epigastric region following meals; intermittent attacks of vomiting; loss of appetite; loss of 10 pounds weight in past year; some tenderness in the left upper quadrant.	200	50	110	Patient left the hospital before an X ray was made.	Histamine test indicates ulcer.
8	58	Pain in the upper part of abdomen appearing 1 to 1½ hours after meals; some nausea; no vomiting; loss of 20 pounds weight in past 2 months; slight tenderness in the upper part of abdomen; no masses palpable.	123	50	59	The stomach is steer-horn type; peristalsis sluggish. There is a constant filling defect in prepyloric region. Cap is normal. Diagnosis, carcinoma of stomach.	Histamine test indicates malignancy.
9	23	No gastrointestinal symptoms. (Control.)	84	58	70	No X ray-----	Histamine test is normal.
10	33	Treatment for duodenal ulcer 6 times in the past 10 years. Complains of distress in the epigastrium not related to meals; no vomiting or tarry stools; physical findings negative.	89	77	91	The gastrointestinal tract is negative.	The acidity is somewhat high.
11	35	Pain in the abdomen immediately following meals; slight nausea; no vomiting; loss of appetite; physical findings negative.	36	81	100	The bulb is irregular. There is constant filling defect. Diagnosis, duodenal ulcer.	The histamine test indicates ulcer.
12	46	Diarrhea of 2 months' duration; sore mouth; sore hands; numbness of legs and feet; failing memory, nervousness, and general muscular weakness. Clinical diagnosis, pellagra.	32	0	0	-----	Achylia which is accounted for by pellagra.
13	37	Pain in abdomen, of 3 months' duration, which comes on before meals and is relieved by food; slight tenderness in epigastrium; some loss of weight.	65	87	95	-----	Histamine test indicates ulcer.
14	33	Patient has had intermittent, dull aching pains in stomach, 2 to 4 hours after meals for past 5 years; physical examination is negative; some loss of weight. Patient had received alkalis up to 12 hours before test.	65	70	82	There is a filling defect in the duodenum. Conclusion, ulcer of duodenum.	This patient's acidity is normal; alkalies probably have lowered it.



Case No.	Age	Brief summary of history	Mils of secretion in 30 minutes	Free HCl	Total acid	X-ray findings	Conclusions
15	51	Pains and tenderness in epigastrium; general weakness; tires very easily; loss of weight; loss of appetite; nausea and vomiting at intervals. There is a hard and irregular mass in the right abdomen, especially tender.	5	0	10	Barium enema, numerous small polyps in lower sigmoid; incontinence of ileosacral valve; liver is markedly enlarged. Conclusion, carcinoma of sigmoid metastatic into liver.	The histamine test is in the malignancy class.
16	27	History of gnawing pain in abdomen, 1 to 3 hours following meals; relieved by alkalis; slight loss of weight; no significant physical findings.	100	54	68	The duodenal cap is irregular; however, no definite filling defect; the appendix is pathological. Conclusion, chronic appendicitis.	The histamine test is normal.
17	31	Slight burning pain in right epigastric region appearing 1 to 3 hours after meals; some loss of weight; physical findings negative.	60	75	86	Ulcer of duodenum is doubtful.	The histamine test is within normal limits.
18	26	Diagnosis, sinusitis. (Control.)	58	73	86	X ray of gastrointestinal system is negative.	The histamine test is normal.
19	37	Loss of weight, persistent cough; slight gastric discomfort following meals.	56	32	43	The gastrointestinal tract is negative; there is a mediastinal mass probably a tumor or abscess. Conclusion, lymphosarcoma.	The histamine test indicates malignancy.
20	33	Asthenia; inability to work; headaches in frontal region, causing emesis; vertigo; epigastric distress, one-half hour after meals; belching relieves condition; patients' muscles are flabby; palpation causes vomiting; no points of tenderness made out.	30	52	64	The gastrointestinal tract is negative.	Acidity is low which is accounted for by patients history.
21	25	Dull, aching pain in epigastrium 2 hours after meals, relieved by eating; alkalis and belching; loss of weight; illness began six months ago; there is some tenderness in the epigastrium.	31	72	83	There is a doubtful duodenal filling defect. Conclusion, doubtful duodenal ulcer.	The histamine test is within limits; normal.
22	45	Dull pain in the region of umbilicus, one-half hour after meals; stomach feels better empty; anorexia and nervousness; slight loss of weight; illness dates over a period of 20 years; there is some distention; slight tenderness on pressure.	19	72	84	The gastrointestinal series is negative.	The histamine test is normal.
23	52	Early morning headaches; constipation; dull, gnawing pain in epigastrium 1 hour after meals, relieved by catharsis; stomach feels better empty; slight tenderness over McBurney's point.	41	55	64	Gall bladder series is normal; gastrointestinal series was not done.	Acidity is low.
24	58	History of cerebral hemorrhage; now has difficulty in speech, swallowing, and vague pain in the arms and legs.	20	30	41	There is a mediastinal mass superior to the aortic arch extending up into the neck; this is probably a mediastinal tumor.	The histamine test is low.
25	56	Intermittent pain in the abdomen, vomiting of blood 1 to 1½ hours after meals; There is a definite mass in the upper left quadrant.	81	113	118	The X-ray examination is positive for duodenal ulcer.	Histamine test indicates ulcer.

Case No.	Age	Brief summary of history	Mils of secretion in 30 minutes	Free HCl	Total acid	X-ray findings	Conclusions
26	25	Epigastric pain following meals; pain is relieved by soda and usually appears about 3 hours after meals; he has had an operation for perforated duodenal ulcer in 1923; There is some tenderness on deep pressure.	180	74	86	The X ray of the gastrointestinal tract is negative.	The histamine test is within normal limits. Ulcer healed.
27	38	Pain in the epigastrium; loss of appetite; distress is aggravated by food and relieved by soda; slight tenderness in the upper left quadrant.	24	61	72	There is a filling defect in the media of the stomach. Conclusion, ulcer of the stomach.	The histamine test is normal.
28	49	Gnawing pain in the epigastrium about 2 hours after eating; pain is relieved by soda and vomiting; slight tenderness in abdomen on pressure.	120	95	103	X-ray diagnosis, pyloric ulcer with adhesions.	Histamine test indicates ulcer.
29	49	Loss of weight, loss of appetite and pep; general muscular weakness; patient is emaciated no other physical findings.	90	78	92	There is some pathology around the duodenum. Conclusion diverticulum.	The acidity is somewhat high.
30	53	Gnawing pain in the abdomen 2 hours after meals; pain is relieved by soda; stomach feels better full; some constipation, etc.	26	0	4	The gastrointestinal tract is negative.	Histamine test indicates malignancy.
31	30	Nausea extreme, vomiting, nervousness, loss of weight; operated on for goiter 1 year ago; symptoms were the same at this time as then; operated second time; section showed a papillary adenoma of thyroid.	90	24	33	No X ray	The histamine test is below normal.
32	60	Cramps in the right side of the abdomen; excessive passage of gas; loss of weight.	60	70	86	The gastrointestinal tract is negative.	The histamine test is normal.
33	44	Intermittent attacks of vomiting of coffee ground material during the past 3 months; loss of weight and appetite; pain in the stomach immediately following meals; no masses made out.	64	49	58	There is a filling defect in the media of the stomach. Conclusion, malignancy of the stomach.	Histamine test indicates malignancy.
34	56	Vomiting of blood following meals; intermittent pain in the abdomen for past 3 years; definite mass in the upper left quadrant.	120	75	85	X-ray examination; positive for duodenal ulcer.	Histamine test in the upper limit of normal.
35	36	Gives a typical ulcer history	112	106	125	There is a constant filling defect in the duodenum.	Histamine test indicates ulcer.
36	39	Pain and gas in the epigastrium; food relieves pain; has had one previous treatment of ulcer; no physical findings.	20	115	128	The X ray is negative.	Do.
37	52	Dull gnawing pain in the epigastrium; appears usually two hours after meals; is relieved by soda, belching, or food; loss of 20 pounds' weight.	40	58	70	The X ray is normal.	The histamine test is normal.
38	35	Severe frontal headache, most severe in the morning; nervousness and loss of appetite; some discomfort in the epigastrium following meals. No physical findings.	39	122	136	X-ray examination not made.	Histamine test indicates ulcer.
39	60	Loss of weight and appetite; vomiting of blood; general muscular weakness; frequent tarry stools; patient is emaciated and shows slight icteric tint; small palpable mass in the epigastrium.	14	0	7	.....do.....	The histamine test indicates malignancy.

Case No.	Age	Brief summary of history	Mils of secretion in 30 minutes	Free HCl	Total acid	X-ray findings	Conclusions
40	38	Pain in the epigastrium immediately following meals; pain is relieved by full stomach; some loss of weight; no significant physical findings.	64	34	43	No X ray taken.	Histamine test is low, indicates malignancy.
41	42	Epigastric distress after meals usually appearing one-half to 2 hours after meals; some loss of weight, nervousness, etc.; abdomen is distended and there is tenderness in epigastrium on deep pressure.	40	91	104	There is a filling defect in the bulb. Conclusion, duodenal ulcer.	Histamine test indicates ulcer.
42	39	Pain in the pit of the stomach one-half hour after meals; onset 6 months ago; loss of weight, constipation; tenderness on pressure 1 inch to left of umbilicus.	33	0	0	X ray not made...	Histamine test indicates malignancy.
43	54	Dull gnawing pain in the epigastrium appearing about 2 hours after meals; pain is relieved by soda and meals; stomach feels better full; onset of illness 4 years ago; abdomen is soft and there is no tenderness.	35	38	52	The gastrointestinal tract is negative.	Histamine test is low.
44	24	Gnawing pain in epigastrium, relieved by soda, belching, and by eating; pain appears one-half to 1 hour after meals; duration 1 hour; slight tenderness 1 inch to left of umbilicus.	68	89	120	-----do-----	Histamine test indicates ulcer.
45	34	Dull gnawing hunger pain in epigastrium 1½ hours after meals; relieved by food and soda, belching; physical findings negative.	140	0	0	-----do-----	Complete anacidity.
46	53	Gnawing pain in the pit of the stomach 2 hours after meals, relieved by soda and food; there is slight tenderness in the pit of the stomach.	39	0	0	-----do-----	The histamine test indicates malignancy.
47	75	Complains of weakness, loss of appetite, jaundice, and failing memory; some difficulty in swallowing, feels like it sticks before it gets to his stomach; the liver is enlarged and nodular. Clinical diagnosis, carcinoma of the liver.	16	0	4	Negative-----	Do.
48	31	Epigastric pain 1 hour after meals, of 3 years' duration; pain is relieved by food and soda; loss of 30 pounds weight in past 8 months; slight tenderness in the epigastrium. Kahn 4 plus.	7	29	31	There is a filling defect in the prepyloric region, which is probably a malignancy.	Malignancy indicated.
49	33	Burning pain in the pit of the stomach 1 to 3 hours after meals, which is relieved by food.	36	121	127	There is a duodenal filling defect. Conclusion, duodenal ulcer.	The histamine indicates ulcer.
50	70	Sudden and unaccounted vomiting of blood, also coffee ground vomitus; tarry stools; small palpable mass in the epigastrium; slight loss of weight.	32	70	85	Examination not satisfactory; probably a carcinoma of stomach.	The histamine test is normal.

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## SUMMARY

1. Histamine is a positive stimulant to the delomorphous cells of the stomach.
2. The use of histamine as a stimulant to gastric secretion is superior to any of the other methods used to date.
3. The results of gastric analysis by the use of histamine are constant and give the true condition of the gastric function at the time used.
4. The secretion is not contaminated by food, is clear, and is easily aspirated.
5. The use of histamine in determining gastric function is worth further study using varying techniques.

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## DIAPHRAGMATIC HERNIA

By W. A. ANGIN, Captain, Medical Corps, United States Navy

Credited with having reported two cases of traumatic origin, Paré, in 1579 described his first case from autopsy on a patient who died following a stab wound of the chest and diaphragm. Examination at autopsy showed most of the colon had passed into the thorax (Watson). Reports and descriptions of this disability are ascribed to Riverius, 1698; Stehelinus, 1724; Kirchbaum, 1755; Morgagni, 1761; and Cooper, 1798. Bowditch, 1846, reported 88 cases in the literature, and Lacher, 1880, collected 276 cases from the literature. Ricolfi, 1886; Naumann, 1888; Walker, 1859; Marana, 1893; and Amante, 1893, operated successfully for traumatic wounds of the diaphragm. Up to 1908, according to Arnsperger, hernia of the diaphragm had been recognized during life only 10 times. In 1912

Giffin reviewed 690 cases from the literature, of which only 15 had been recognized before death. In the same year Scudder reported records of 53 patients who had been operated upon (Watson).

During the past 15 years the literature on the subject has accumulated rapidly coincident with the use of X-ray technique in diagnosis. By 1925 Hedblom was able to review a total of 378 cases in which operation had been performed.

The adult anatomy of the diaphragm is so well described in any standard textbook on anatomy that it is not repeated here. It is enough to recall that the weak areas of embryological fusion are the foramina of Bochdalek and Morgagni, the outer crux and esophageal opening. Hernia might be expected at any of these points. Although hernia of the central tendon (dome) is common; it can not be explained on this basis, because the dome is not a fusion area.

Numerous classifications of diaphragmatic hernia are based on embryology, etiology, pathologic anatomy, the site of the opening in the diaphragm, the presence or absence of a sac, the contents of the hernia, and other conditions. It is difficult or impossible to make most of these classifications clinically; they can usually be made only after operation or at necropsy. From a clinical and surgical standpoint, the history of injury is important in determining the type of treatment to be instituted and the probable prognosis in surgical cases. Better results are usually obtained from operation in cases of traumatic origin than in the cases due to embryonic defects. For this reason Harrington has classified all types in two main groups, nontraumatic and traumatic, and subdivided these according to the various common types as follows:

**I. Nontraumatic:**

1. Congenital, due to embryonic deficiency, of which the most common sites in probable order of frequency of occurrence are: (a) Through the hiatus pleuroperitonalls (foramen of Bochdalek) without an inclosing sac, (b) through the dome of the diaphragm, (c) through the esophageal opening, (d) through the foramen Morgagni, and (e) through the gap left by absence of the left half of the diaphragm.
2. Acquired after birth through an embryonic fusion point of the diaphragm; it may occur at sites under congenital types.

**II. Traumatic:**

1. Indirect injury to diaphragm; it may occur at any point but usually through an embryonic fusion point, the result of crushing injuries and usually with a sac.
2. Direct injury to the diaphragm; the hernia may occur at any point and is usually the result of penetrating wounds (gunshot and knife wounds) and usually without sac.

The symptoms are inconstant, depending, of course, upon the organ or organs involved in the hernia. Most often the patient is suspected of gall bladder disease or peptic ulcer. Logically there

should be symptoms referable to the abdomen and to the thorax, the former due to the organ involved and the latter to encroachment on the heart and lungs. Dyspnea, palpitation of the heart, cyanosis, and pain in the chest; epigastric pain, sensation of smothering, and vomiting are recorded as the cardinal symptoms.

Of the 27 surgical cases operated at the Mayo clinic since 1908, the most constant symptom was epigastric pain; it was noted in practically all cases. In four cases it radiated to the thorax anteriorly, in three cases to the back, and in two cases to the left shoulder. The other symptoms in order of frequency were regurgitation of sour fluid or food, vomiting, gastric distress, and distention with difficulty in belching of gas at times, distress immediately after eating, hemoptysis, and melena (Harrington).

Diagnosis by means of the history alone is problematic. The definite establishment of the diagnosis is by means of the X ray or by surgical exploration. Differentiation in diagnosis by the use of X ray, according to Le Wald, is to be made between—

- (a) Congenital absence of the left half of the diaphragm.
- (b) Thoracic stomach, a congenital defect in which the stomach is located above the diaphragm.
- (c) Eventration of the diaphragm, in which the diaphragm itself may ascend as high as the second rib.
- (d) Congenital hernia.
- (e) Acquired hernia.

Some patients with mild symptoms may be treated with palliative or nonsurgical measures, but no cure can be expected without operation.

The operations reported have had uniformly successful results.

There are three choices of incision for operation: (a) Abdominal, (b) thoracic, and (c) combined.

(a) Abdominal approach is made on the left side, through any standard upper abdominal incision, and is indicated when injury to abdominal viscera is suspected or when the injury is posterior to the dome of the diaphragm. It is the method of choice.

(b) The thoracic route is indicated when the wound is anterior to the dome or when there are adhesions to pleural surfaces. It is claimed also that abdominal viscera can be more easily returned to the abdomen. The usual incision is made between eighth and ninth ribs and a rib spreader used. It may be necessary to resect one or more ribs or a portion of the costal arch. Watson describes an incision that follows the costal arch from the ensiform to the ninth interspace, then upward into that interspace.

(c) The combined operation is often necessary in difficult cases. Separate incisions may be made in abdomen and thorax, using the

standard incisions, or a single incision may be made which exposes both cavities simultaneously. This incision begins in mid-axillary line and extends forward in the seventh interspace, curves downward over the rectus to the midline, then downward to the umbilicus.

Two cases of hernia of the abdominal contents into the pleural cavity have come to my attention, both, strangely enough, at about the same time. The second of these cases was an enlisted man in the Navy who had been killed in an automobile accident and whose body was brought to the naval hospital, San Diego, 1924, for autopsy. Examination revealed a tear in the left dome of the diaphragm, through which had passed a large portion of the adjacent abdominal organs, part of the stomach, the spleen, the left edge of the liver, and part of the transverse colon.

The report on the first patient follows:

L. T., a small-framed woman, aged 38, married, weight 105. Has had three children, all well.

Her chief complaint and the one for which she is seeking relief is nausea. This nausea is irregular in time and has no association with meals. It is particularly distressing in the evening and interferes with her social enjoyment, as it is very apt to come upon her while she is in the midst of a social gathering. This nausea almost never leads to vomiting but is quite often associated with a sensation of shortness of breath. Sometimes the shortness of breath comes on without nausea.

The patient came to the hospital for radiographic study of the gastrointestinal tract. The physical examination and the history had been inconclusive. The diagnosis of hernia of stomach through left diaphragm was made by X ray.

*Family history.*—Negative for present illness.

*Past history.*—As a girl, and during her twenties, she had frequent attacks of indigestion and often complained of sensation of a hard lump in the epigastrium. This went away at the time her first baby was born, 11 years ago, and has not since returned. She had no pain in stomach region after that; in fact, she was unusually healthy and free from the usual ills until April, 1921, when she was severely injured in an automobile accident in which she was crushed against the steering wheel and sustained a fracture of the pelvis and the left tenth and eleventh ribs. X ray shows the site of the rib fracture to be about 3 inches from posterior end of rib. She also complained of a sensation of "gas" in her left side (thorax and abdomen) that interfered with her breathing. This was, at the time, attributed to the broken ribs. Drinking hot water generally relieved it. She was eight weeks in hospital as a result of this accident.

*Present history.*—Beginning just after this accident, she has had frequent attacks of this nausea and shortness of breath, which she gives as her chief complaint. She has never noticed any palpitation but her pulse is rapid, about 100 at time of this examination. The nausea and dyspnea pass off if she lies down for a short time. This she frequently has had to do at social gatherings or at home in the evening. In the morning she is generally free from symptoms, except after some form of exertion, mostly those that increase intra-abdominal tension such as stooping over at work.

When the attacks come on she experiences an "all gone" feeling in the pit of the stomach, but has never fainted. Twice, as a result of stooping over, she had severe pain, once in right flank and once in left.

*Physical examination.*—The first physical examinations were inconclusive. Nothing definite could be made out pointing toward any abnormal conditions. After X rays were taken and the diagnosis established, Doctor White made a physical examination and recorded his findings as follows:

"*Chest.*—Heart dullness, while lying down, 5 centimeters to left of midline, 2½ centimeters to the right. Sitting up, the area of dullness moves about 2½ centimeters to the left. Heart sounds are clear, no adventitious sounds.

"On percussion, while lying down, a tympanitic note is found in left axilla and anteriorly. Upper limit of area of tympany extends from eighth interspace in midaxillary line (where it ends in splenic dullness) upward and forward, crossing the sixth interspace at anterior axillary line and reaching the fourth interspace in the nipple line, where it turns abruptly downward to end in colonic tympany in the abdomen. On sitting up, the tympanitic area disappears, to reappear only after patient has been lying down for a minute. The outlines of the area change slightly from minute to minute. On auscultation loud gurgling noises can be heard over lower anterior chest. Breath sounds are vesicular except over lower anterior chest where they are abolished."

*Operation.*—March 27, 1924. Either anaesthesia. From the fluoroscopic examination it was pretty thoroughly demonstrated that the hernial opening was in left diaphragm posteriorly. It was, therefore, decided to enter from below. An incision 5 inches long was made through left rectus extending from ensiform notch to umbilicus. The liver and gall bladder were normal.

Exposing the lower surface of the left diaphragm, the free edge of a tear could be made out. This was about 5 inches long and extended from the left crux to the left thoracic wall at approximately the posterior axillary line. It will be recalled from the history that the left tenth and eleventh ribs were fractured. To my mind the tear in the diaphragm was the direct result of trauma from the fractured ribs, most likely due to a puncture by a broken end of rib.

Further examination of the hole showed that the fundus of the stomach, a part of the transverse colon and its splenic flexure, a loop of small intestine, and the spleen were in the chest cavity. The lung was collapsed with no adhesions. Pericardium felt normal. I believe that only the stomach was in the thorax prior to releasing the negative pressure at the time of operation, when the lung collapsed and the other organs were drawn in to fill the void. The hole was large enough to admit the hand. The abdominal viscera were drawn out and held down by retraction and laparotomy pads, the patient being in the reversed Trendelenburg position. The free edge of the diaphragm was not taut but hung flaccid and loose. Its edge could easily be approximated to the tissues of the posterior wall, which was about 2 inches away at middle of the opening.

Difficulty was found in recognizing definitely the posterior remnant of the diaphragm. It seemed to be fixed tightly down over the superior pole of the kidney, to be absent altogether in the center behind the spleen, and to be present as a short tag near the outer angle of the wound. It was decided to stitch the free edge to this thickened tissue over the kidney's upper pole and to the loose tissue behind the spleen and to the outer tags. This was done by use of mattress sutures taken through the tissues of each edge separately, the two opposing sutures being tied across the wound later, after the suggestion of Soresi.

The inner end of suture line was reinforced by a second continuous suture and the extreme angles of the wound were reinforced by two through-and-through sutures. All sutures were of 20-day No. 2 chromic gut.

The abdomen was closed without drainage. This abdominal wound gave good operating exposure.



The subsequent history of the wound was normal. Healing was primary and stitches were all removed by the tenth day.

A check X ray on the fourteenth post-operative day showed a diffuse cloud in the left chest. Physical signs indicated considerable fluid in the left pleural cavity. Six hundred cubic centimeters of a slightly cloudy reddish-tinged fluid were aspirated. The laboratory reported presence of red and white blood cells, culture negative. Ten days later 1,600 cubic centimeters more of fluid were withdrawn. Subsequent to this, the course was uneventful.

The patient left the hospital on the fourteenth post-operative day, returning for the second chest aspiration and X-ray photographs.

X-ray examination six weeks after operation shows good lung expansion on left side and the domed left diaphragm holding perfectly.

X ray made in 1925 shows no pathology.

The operation relieved the patient of her symptoms. Immediately following it she began to gain in weight. Within six months she had gained 17 pounds and began to be fearful of getting too fat. A report dated September 27, 1926, from her physician states: "She has held her weight at 122 ever since her original gain after operation. All her gastrointestinal symptoms were relieved and the strained, rather worn look in her face has disappeared. She now looks about 10 years younger than before operation, feels perfectly well in every way, can eat anything she cares to without the slightest symptom."

It is quite unlikely that the diagnosis of hernia of the diaphragm would have been made, or even suspected, in this case, were it not for the X-ray examination. There is nothing definite about the symptomatology that can be grasped on which to build up more than a probable diagnosis of gall bladder or gastrointestinal disease. That she came for a gastrointestinal X-ray series is significant of the doubt existing at the time she entered the hospital.

The history of indigestion in her earlier years might have led the investigation along that line. Perhaps a gall bladder or duodenal ulcer was suspected. The kidney might just as well have come under suspicion because the pain she complained of was relieved by lying down.

The most important item in her history is that her symptoms came on subsequent to a severe accident. Without the X ray or an exploratory operation the diagnosis would not have been established.

I am indebted to Capt. E. C. White, Medical Corps, United States Navy, for certain features of the medical history, and to Lieut. Commander J. B. Farrior, Medical Corps, United States Navy, for the X-ray work.

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#### MYIASIS—CASE REPORT

By G. W. COOPER, Lieutenant, Medical Corps, United States Navy

H. J. R., A. S., United States Navy. White, American, 20 years of age, admitted to sick bay aboard U. S. S. *Antares* at Guantanamo Bay, Cuba.

*Chief complaint*.—Tinnitus, impaired hearing in left ear, and a serosanguinous discharge from left ear. Cough, weakness, and emaciation.

*Present illness*.—Onset gradual over a 2-day period with "noises in head" and restlessness. The blood-streaked discharge was noticed the morning patient reported to sick bay, or 48 hours after symptoms were first noticed. Hearing in left ear impaired for past week or 10 days. Bloody discharge noticed when patient removed a mass of crustlike cerumen which was hard and had formed a cast of the external auditory canal.

Patient has had a dry cough, poor appetite, and weakness for the past month; he is also 15 pounds underweight (loss not progressive).

*Past history*.—Measles and mumps in early youth; both apparently uncomplicated and without sequelæ. No history of serious illness. Denies venereal disease. Frequent sore throats and colds during past year. Had a severe attack of catarrhal fever, acute, two months ago and has had a dry cough since then. Cough slightly productive at times, such as upon arising from sleep, but there is no blood (thick, tenacious, mucopurulent, but not profuse in amount).

*Family history*.—No tendency to cancer, tuberculosis, anemias, etc.

*Habits*.—Cigarettes in excess at times but no alcohol, drugs, or other excess. Appetite poor. Bowels irregular. Does not sleep well. Patient is a ship's

baker and sleeps during the day in the after peak tank hold, where ventilation is not ideal and sunlight does not reach.

*Physical examination.*—General appearance poor. Underweight, and facies and membranes anemic in appearance.

*Head.*—Contour and hair normal. Ears, function impaired upon left side; left auditory canal almost entirely occluded by a cast of mixed soft and hard cerumen. Signs of a recent otitis externa are present. A slight secretion of a blood-streaked serum is present. Otoscopic examination revealed parts of the bodies of three or more larvae. They were alive, moving, and, upon manipulation, proved to be quite numerous (the case record shows that nine were removed on the second day of treatment). Eyes, normal. Nose, normal—no signs of nasal myiasis. Mouth, oral hygiene good. Tonsils, atrophic but show a chronic process.

*Neck.*—Two anterior cervical glands, left, enlarged.

*Thorax.*—Contour poor, ribs prominent. Mean measurement, 28 inches; expansion, 3 inches. Bronchial râles over large bronchial area during late inspiration; do not clear upon coughing. No crepitation, impaired resonance, or changes in fremitus. Heart, apparently normal.

*Abdomen.*—Negative.

*Genitalia.*—Negative.

*Extremities.*—Negative.

*Diagnosis.*—(1) Myiasis, left ear. (2) Bronchitis, subacute. (3) Anemia, simple, secondary.

*Laboratory.*—Hemoglobin, 75 per cent (Tallquist); red cells, 4,000,000; white cells, 7,200. No abnormal cells observed. Color index, 1.06 (approximate).

*Urinalysis.*—Normal.

*Larval specimens.*—Sarcophagidae (United States Naval Medical School).

The genus *Sarcophaga* is common in tropical America and is prone to deposit the larvae upon meat. Other foods are also used by these flies but putrefying meat is their preferred depository. They may be often met with aboard ships in certain waters and the myiasis danger becomes a real one.

*Identification.*—Stigmal plates in a groove, but without the button; slits in opposite plates are subparallel.

*Prognosis.*—The larvae, developing from eggs deposited in body orifices or cavities, burrow into adjacent tissues and often cause extensive and severe necrosis of all soft parts in the region. The mortality is high. It was 15 per cent in Yount's series of 23 cases of *Chrysomya macellaria* (screw worm). The nasal myiasis cases gave a 22 per cent mortality (Stitt).

In the case here outlined recovery was apparently complete by the morning of the fifth day, when exploration and irrigation showed no more larvae present; neither has there been recurrence nor a sign of sequelae.

*Treatment.*—This case was treated, with resulting early and effective action, by the use of chloroform water and 5 per cent phenol, each applied upon alternate days; both were used three times daily. By the fifth day there were no more larvae in evidence. There was a ragged laceration at the mid-anterior margin of Shrapnell's membrane and a pronounced otitis externa. On the fifth, sixth, and seventh days the otitis was treated by three instillations daily of the alcohol-boric-bichloride mixture. The treatment was a combination of two methods given in textbooks with the complementary procedure for the otitis externa. This combination of treatments appears to be rapidly and highly efficacious.

Because of a subacute bronchitis and anemia, general supportive treatment was also given and dietary regimen designed to correct the underweight. Cod-liver oil was given, sunlight prescribed, and the patient removed from below-deck to above-deck sleeping quarters.

Six months later the patient was only 6 pounds underweight and had no cough or other symptom of bronchitis. Hæmoglobin (Tallquist) now 80. No recurrence of the myiasis or otitis. Erythrocytes now 4,200,000. Leukocytes, 7,800. Differential, normal. Color index, 1.07 (approximate).

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#### BILATERAL GLIOMA—REPORT OF A CASE

By W. H. FUNK, Lieutenant, Medical Corps, United States Navy

J. K. T. was admitted to the United States naval hospital, Portsmouth, N. H., March 18, 1929, with diagnosis undetermined (neuritis, right musculospiral nerve). For about one month previous to admission patient had noticed increasing difficulty in using his right hand while holding a cigarette, lifting a glass, or shuffling cards. Also, his right leg had seemed to be weaker than his left, and he favored the right side of his body when walking. The patient had worried about his work considerably, bothering about petty details and seeking advice from his juniors more often than formerly.

Physical examination showed a well-developed, well-nourished man of 50 years, who answered questions intelligently and seemed anxious to cooperate. This examination was negative except for markedly diseased tonsils. Routine laboratory procedures as urine, blood, and Kahn were negative. Neurological examination showed some loss of power to completely close the right eyelid, diminution of movement of lower right side of face, grip of right hand, and muscular power of right arm much weaker than that of the left. There was no impairment in regard to touch or temperature noted. Biceps, triceps, periosteal, radial, knee kicks, and ankle jerks were hyperactive but equal on both sides.

Tonsillectomy was done on March 26 for badly diseased tonsils. The patient exhibited an unusual reaction following tonsillectomy, becoming very nervous and restless and afraid of being left alone. He developed periods of depression, requesting large doses of morphine to kill him and put him out of his misery, alternating with periods of restlessness and insomnia. His weakness gradually increased, and there was marked loss of movement of the entire right side of his body.

Spinal puncture on April 1 showed increased pressure, a cell count of 186 (all large mononuclears), negative globulin, negative Kahn, and negative colloidal gold. Examination by a neurological consultant on April 4 showed right elbow, wrist, and phalangeal joints flexed and entire right upper extremity held in a spastic condition. A slight amount of extension of the right arm was possible by strong passive movement, but any attempt at extension caused the patient great pain. There was at this time an increased right biceps reflex and a diminished right knee kick. The patient was in a typical lethargic attitude from which he could be aroused. The consultant gave his differential diagnosis as between brain tumor and epidemic encephalitis, and advised continued observation and frequent spinal punctures to determine diagnosis. Spinal puncture on April 6 showed slightly increased pressure, cell count of 60, and negative globulin. Spinal puncture again on April 15 and April 29 showed normal pressure, normal cell count, and normal findings.

The patient continued in his lethargic state, able to whisper a few unintelligible words when aroused. The condition of his extremities remained about the same except for a slight decrease in the spasticity of the right arm. On April 30, due to the unchanged mental condition of lethargy and the absence of symptoms of a focal nature, the diagnosis was changed to lethargic encephalitis. On May 3 the patient had a short convulsion consisting of clonic and tonic contractions of the right side of the face, right arm, and right leg. On May 4 the eye grounds showed bilateral choking of the discs, although repeated previous examinations of the eye grounds had been negative. On May 6 the patient showed clinical signs of a bronchopneumonia with increased temperature, pulse, respiration, and leukocytosis. On May 8 the diagnosis was changed to glioma, left cortex, motor area. On May 11 the patient died of a terminal bronchopneumonia.

Post-mortem examination showed numerous dural adhesions. There were no evidences of meningitis. In the right frontal lobe there was an elevated area about 1 inch in diameter. Section here revealed, about one-half inch below the surface and extending to the base of the brain, a yellowish pink gelatinous mass with an ill-defined border showing marked venous congestion and pin point hemorrhagic areas. On the left side in the motor area there was a similar but smaller mass, more congested and less yellow in color.

Tissue from both of these tumor masses was forwarded to the United States Naval Medical School, Washington, D. C., and the following pathological report was received:

"Sections from both specimens show the tumor and cerebral tissue. The tumor is rather cellular, being made up of thick spindle-shaped cells with occasional large forms. Mitotic figures are fairly numerous. The edge of the tumor infiltrates the normal tissue forming an indistinct border. Blood vessels are numerous and congested. Several large sinuses filled with blood are noted. In some sections areas of necrosis are seen. Pathological diagnosis: Glioma (Spongioblastoma) cerebrum."

This case is reported because of the following unusual features. There were no definite symptoms referable to the right frontal lobe tumor, which appeared to be the older of the two lesions. Following the tonsillectomy and persisting to the end there was a lethargic state almost typical of epidemic encephalitis. The spinal fluid at first showed a cell count suggesting meningeal irritation, but later returned to normal. Two tumor masses were found at autopsy, one in each side of the brain.

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#### BALANITIS NONVENEREAL

By F. R. MOORE, Lieutenant (Junior Grade), Medical Corps, United States Navy

A balanitis which is purely nonvenereal in origin is certainly infrequent, if not rare.

Lowseley and Kirwin, in their textbook of urology, refer to a "Streptococcic balano-preputial intertrigo," and cite a case report by Montgomery (1) in which the infection was transferred to the penis from streptococcic infection of the left leg.

Another type of balanitis was first described in this country by Corbus and Harris (2). It is usually referred to as a fourth venereal disease, or simply as an erosive balanitis. Bacteriologically it is caused by a dual infection of a vibrio and a spirochete. These same organisms are found in Vincent's angina and noma. The condition is usually associated with persons having a long tight prepuce.

The case of balanitis here described is apparently closely associated with attacks of acute bronchitis. The possibility of perverted practices was carefully investigated, and I believe were not responsible for the condition.

G. A. H., private, United States Marine Corps, age 24, was admitted to the Third Brigade field hospital, Tientsin, China, August 8, 1928.

*Diagnosis.*—Bronchitis, acute.

*Present complaint.*—Painful cough, fever, and a painful and swollen penis.

*Present illness.*—The cough was first noticed on August 2, 1928, and gradually became worse. On August 4, the glans was tender to touch and slightly swollen. The following day the glans appeared inflamed, and on August 6 there was a beginning exfoliation, leaving a very tender raw surface exposed. Last sexual intercourse four months prior to onset.

*Past history.*—Childhood diseases, mumps and measles; circumcision, 1926; venereal diseases denied. Patient states that he had a similar condition in 1924, and again in 1926, which started as a cough, and was followed in a few days by a painful swelling confined to the glans penis, and later exfoliation, which healed promptly following the subsiding of the cough. A circumcision was performed in 1926, following the second attack. Each attack lasted about two weeks. Patient states that he was not exposed for several weeks before the attacks in 1924 and 1926.

*Examination.*—Temperature, 101° F.; pulse, 90; respiration, 20.

*Head and neck.*—Eyes, ears, and nose, negative. Pharynx, moderately congested. Neck, negative.

*Chest.*—Lungs, apices and bases clear. Persistent rales over the main bronchi. Heart, normal. Blood pressure, 118/76.

*Abdomen.*—Negative.

*Reflexes.*—Normal and equal.

*Genitalia.*—There is a moderate swelling of the glans penis. About three-fourths of the mucosa has been eroded. There is moderate swelling in the line of the circumcision scar.

*Laboratory.*—Blood culture August 9, 1928, negative. White count August 9, 1928, 16,200, poly's 81 per cent; S.ly. 17 per cent, eosin, 2 per cent. Culture from glans, reported as a short chained nonhemolytic streptococcus. Kahn, negative. Three darkfield examinations failed to reveal any type of spirochete. X ray of lungs, diagnosis—acute, bronchitis. Numerous sputum examinations revealed a short chained nonhemolytic streptococcus, culturally the same as the one found on the glans penis. Urine, normal.

The patient's cough and temperature had subsided at the end of five days. The balanitis healed rapidly without treatment, and the mucosa had completely regenerated at the end of the fifteenth day.

The association of this balanitis with three consecutive attacks of acute bronchitis, and the culturing of the same type of organism from the sputum

and glans penis makes it appear highly probable that the same organism caused both conditions.

The route of infection might have been through the blood stream or from the sputum by contamination.

#### REFERENCES

- (1) Montgomery, D. S.: Streptococcal Balanopreputial Intertrigo. Urol., and Cut. Rev., 1919, 23, 90.
- (2) Corbus, and Harris: Journal of American Medical Association, 1909, 1474.

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#### SENSATIONS UNDER LOCAL ANÆSTHESIA

By M. D. WILLCUTTS, Lieutenant Commander, Medical Corps. United States Navy

It has been my conviction for a long time that intestinal lesions, wherever accessible, should be operated upon under local anæsthesia. The quiet abdomen, so nicely obtained, permits of fine localization of work so that operative trauma and spread of infection when present may be controlled in a large measure. The most common surgical intestinal lesion is appendicitis. Ordinarily an appendectomy is a simple procedure but not infrequently constitutes a dangerous, difficult operation. During the past several years I have employed local anæsthesia exclusively for all types of appendicitis. The abdomen reacts beautifully, there is no distension, no severe postoperative distress; pulmonary complications occur but never as severely or as frequently as under general anæsthesia. Deaths have been reduced to a fractional percentage and then only when the appendicitis was accompanied by tuberculosis or grave constitutional disease. If the appendix fails to present and it is difficult to find and deliver, when adhesions make traction on adjacent peritoneal attachments, operative distress may become severe. At this stage a brief period of general anæsthesia may be employed. This has rarely been found necessary if patience be exercised and manipulations carried out under gentle local operative technique. The reward is quick and pleasing when, with freeing of the meso-appendix, you see the patient at ease, strength and condition good, fully able to care for himself.

As a medical officer I have been impressed most favorably with the practical elimination of postoperative complications and the routine rapid uneventful convalescence from appendectomies performed under local anæsthesia. Now, from the standpoint of the patient, I wish to pay tribute to the method and describe in detail the sensations experienced while undergoing appendectomy. The ileo-costal block and the regional infiltration method has given the most satisfactory anæsthesia in our hands. Spinal anæsthesia is considered an unnecessary major procedure for appendectomy unless

preoperative peritonitis is present and unconfined, then it may prove truly life-saving.

CASE REPORT<sup>1</sup>

The operating suite was entered without the usual preliminaries. I had taken no preoperative narcotic, no cathartic, no enema, but was in very fit condition, my last attack several days before having left only mild, deep-seated, subsiding tenderness.

The anæsthesia was one-half per cent procaine with adrenalin, a regional infiltration. This was painless, the faint prick of the first needle being just perceptible. I was able to follow the advancing needle for the deep injections. Passage of the needle through the external oblique aponeurosis gave the impression that the operator notes when he pierces the dura for spinal puncture. I noted a heaviness, a ballooning of the subfascial planes. Once as the peritoneum was bathed the sensation of deep pressure on the eyeball or pressure on the testicle was felt. None of these sensations were painful, all fleeting and ordinarily would probably have passed unrecognized.

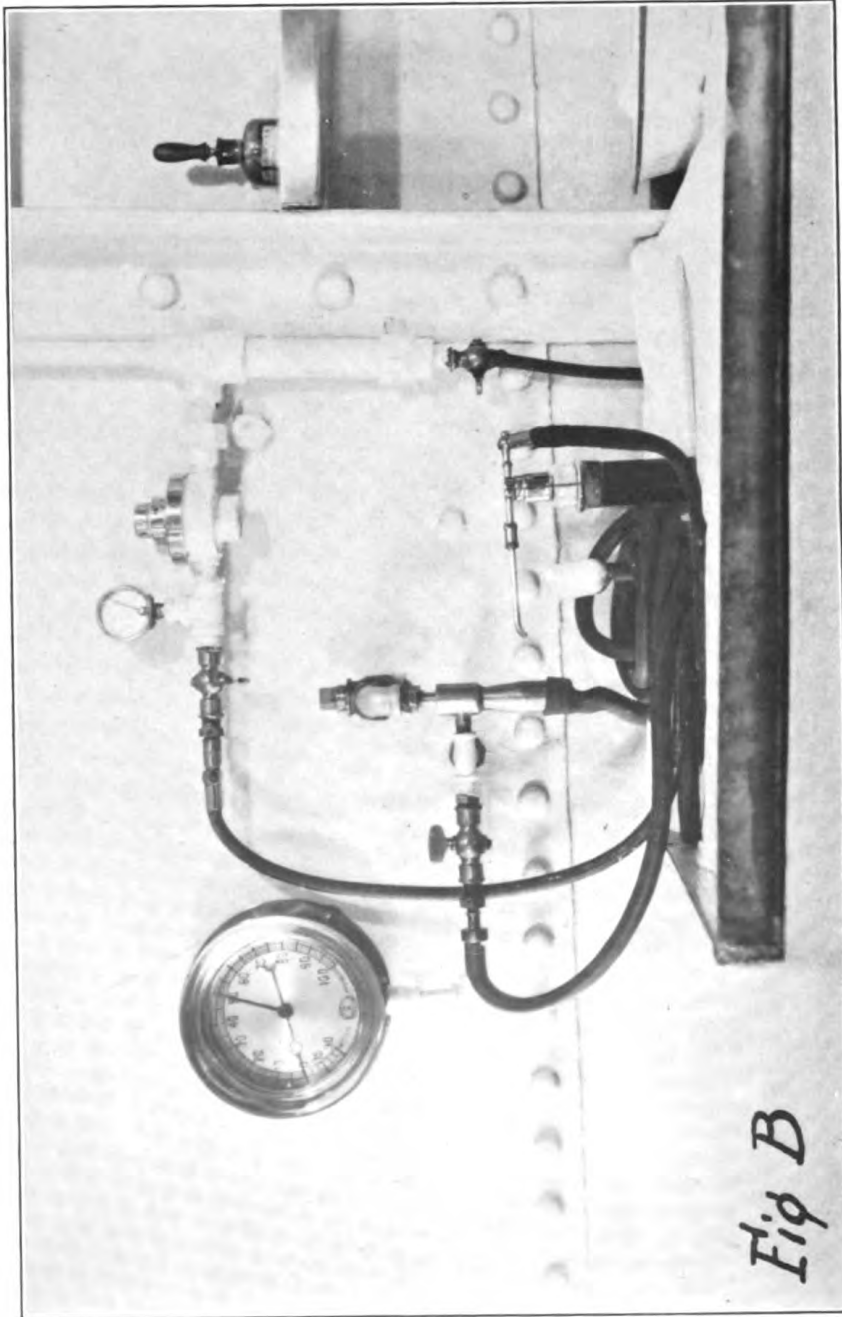
I donned a face mask and by elevation of my head and shoulders on pillows was able to follow clearly all the extraperitoneal manipulations. Transit through the skin, fascial, and muscular layers was painless. I witnessed the peritoneal incision, could clearly see the cecum. Dull pressure only was noted up to this point except for a fleeting twinge felt as each of the 8 minute subcutaneous blood vessels were ligated. I could distinguish little or no difference in vertical or horizontal traction; the latter produced an unpleasant dragging sensation, not pain, when carried to a degree of force at my request. Gentle vertical peritoneal traction was painless. The peritoneal incision was painless. Elevation of the cecum upon the abdominal wall produced a faint ache, the degree depending upon traction of the peritoneal attachment and not manipulation of the cecum itself. The appendix did not present. An exploratory finger gave the first disagreeable sensation, a coliclike cramp radiating to the epigastrium but not felt at site of operation. This cramp was controlled and eased by cessation of exploratory manipulations. The appendix was buried beneath an inflammatory membrane, invaginated within the cecal wall, was small, atrophic, with bulbous tip. After a couple of rest periods to ease the epigastric colic, the appendix was mobilized and brought into the wound. Ligation of the vascular meso-appendix again produced cramps and for an instant intense nausea was felt. This was fleeting, not followed by vomiting. The meso-appendix was injected before ligation. The benefit from this procedure could not be determined but

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<sup>1</sup> The notes which form this report were made on the day of operation.







(Camerer)

POSITIVE-NEGATIVE PRESSURE APPARATUS

119-1

was probably masked by the necessary additional manipulation of the meso-appendix. Any traction on the meso-appendix produced cramps; when severe, nausea. The clamping of the appendix and amputation with the electric cautery produced no sensation. The dropping of the stump and the replacement of the cecum was painless. The closure of the wound was without pain; the running suture through the aponeurosis gave the impression of a light chain or knotted cord being drawn through. The epigastric cramps rapidly subsided once the meso-appendix was freed and all distress was entirely gone by the time the peritoneum was closed. At the completion of the operation I felt able to have gone unassisted to my room. Operation started at 8.14 a. m., pulse 80. Operation closed at 9 a. m., pulse 92. My convalescence was rapid and uneventful. I experienced no so-called gas pains, required no cathartic, no enema. The operative wound gave the impression of a deep bruise only. It healed cleanly. I was up, fully dressed, on the fourth post-operative day, back to duty on the ninth. This at sea, en route from the Canal Zone to San Pedro, Calif., on the U. S. S. *Relief* March 14, 1929.

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#### A DEPENDABLE POSITIVE-NEGATIVE PRESSURE INSTALLATION

By C. B. CAMERER, Commander, Medical Corps, United States Navy

The use of a dependable positive-negative air-pressure apparatus for the atomizing of spray solutions, sinus work, Bier's hyperemia, etc., is essential in the care and treatment of numerous conditions confronting the medical officer afloat. Unfortunately the small electrically driven air compressor now supplied, while excellent in so far as its capacity permits, is often found lacking when needed most, e. g., during outbreaks of numerous "head colds," influenza, etc., causing embarrassment and annoyance and requiring frequent repairs and adjustments.

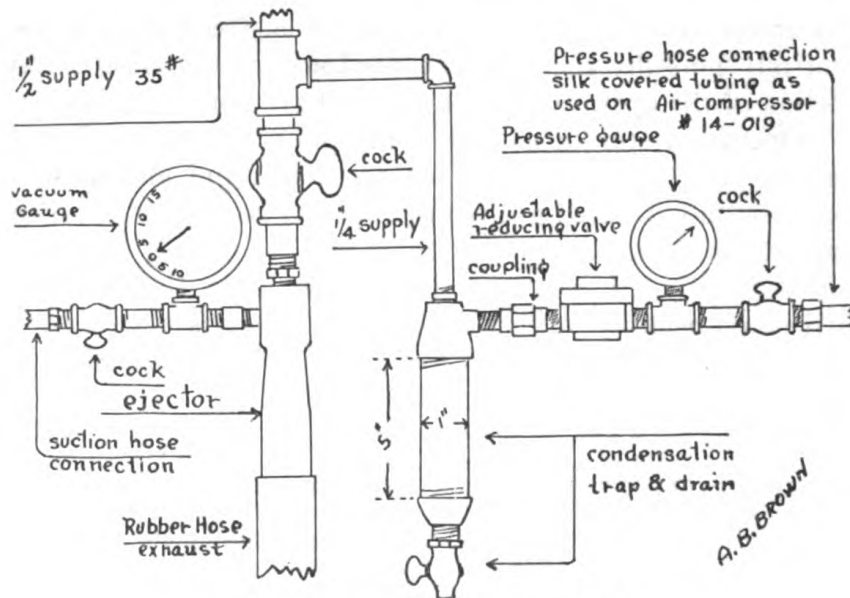
A drawing, Figure A, and photo, Figure B, of an installation to meet all requirements at all times worked out and set up on this vessel by Lieut. Robert P. Briscoe, United States Navy, assistant engineer officer, and the writer is submitted. It is very compact, takes up but little space, is readily installed by the ship's force, and requires practically no attention.

The air supply, taken from the fuel oil pneumericator system of supply, consists of a ½-inch line carrying 35 pounds positive pressure. Figure C illustrates the suction or negative-pressure unit in detail, which gives an adjustable capacity of from 0 to 16 inches of negative pressure.

The total cost of the entire set-up, excluding gauges and reducer, is slightly under \$10, the gauges and reducer being obtained from salvaged material on board.

An extension pressure line has been led into the dental office for the use of the dental officer.

Attention is invited to the low cost, positive service, and independence of any electrical connection and the saving in cost of the two

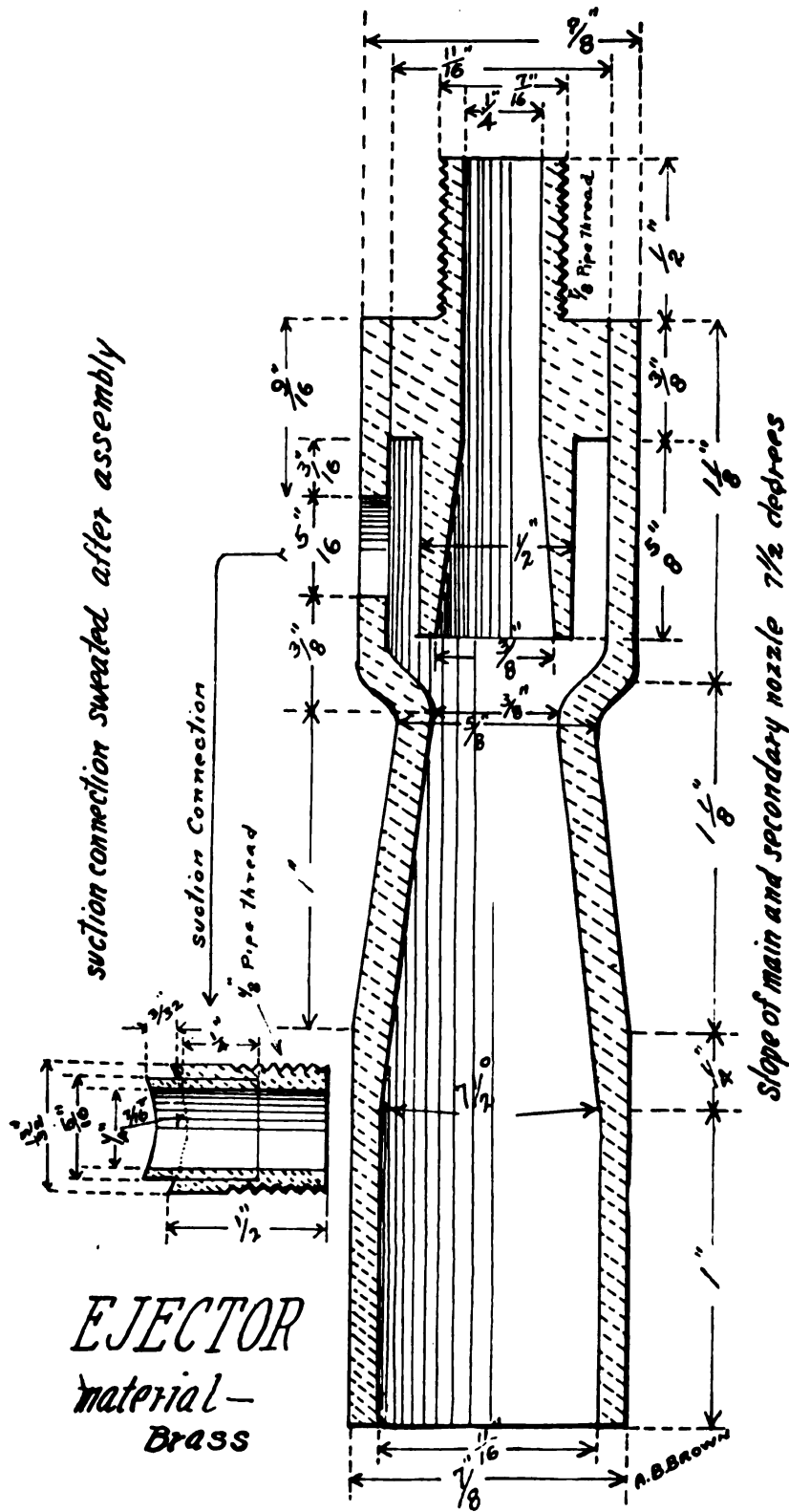


*GENERAL DIAGRAM OF CONNECTIONS*

FIGURE A

small electrically driven air compressors at present supplied to ships of this class. The apparatus can readily be manufactured and installed on board almost any ship and has proven thoroughly reliable and dependable.

The writer wishes to sincerely thank Lieutenant Briscoe for his efficient cooperation and technical ability in making up this installation, and due acknowledgment is made of the assistance and working drawings contributed by A. B. Brown, chief pharmacist's mate, United States Navy.



**EJECTOR**  
material—  
Brass

FIGURE C

73893—20—9



## NAVAL RESERVE

### *Commissioned in the Medical Corps of the Naval Reserve*

Name	Rank	Class	Appointed
Black, William C.....	Lieutenant (junior grade)...	MC-V(G).....	May 25, 1929
Crosby, Leonard G.....	Lieutenant commander.....	MC-V(S).....	July 7, 1929
Fulcher, Oscar Hugh.....	Lieutenant (junior grade).....	MC-V(G).....	July 30, 1929
Graves, Roger Colgate.....	Lieutenant commander.....	MC-V(S).....	Sept. 3, 1929
McElwain, Clifford E.....	Lieutenant.....	MC-V(G).....	Aug. 5, 1929
Rapaport, Walter.....	Lieutenant (junior grade).....	MC-V(G).....	July 2, 1929
Searls, Henry Hunt.....	Lieutenant commander.....	MC-V(S).....	Aug. 14, 1929
Thompson, Ferris W.....	Lieutenant (junior grade).....	MC-V(G).....	July 29, 1929
Waggoner, Charles Van Epps.....	do.....	MC-V(G).....	Sept. 6, 1929
Warfield, Chester H.....	do.....	MC-V(S).....	May 27, 1929
Wilson, Leonard L.....	Lieutenant.....	MC-V(G).....	Aug. 23, 1929

### PROMOTIONS

	From—	To—	Date
Leighton, Adam Phillips.....	Lieutenant (junior grade) MC-V(G).	Lieutenant commander MC-V(S).	July 9, 1929
Macaluso, Anthony.....	Lieutenant (junior grade) MC-F.	Lieutenant MC-V(G)....	Aug. 23, 1929





# NURSE CORPS

## NATIVE NURSES IN SAMOA

By HELEN S. WOOD, Chief Nurse, United States Navy<sup>1</sup>

It is a great pleasure to introduce to you this evening the five nurses who form the twelfth graduating class of the Samoan Hospital Training School for Nurses.

These young women entered training in October, 1925, eager to begin the work that would enable them to be of service to the Samoan people. During almost four years they have kept that thought of service in their hearts, have worked and studied, obeyed orders faithfully and cheerfully, and have sacrificed rest and pleasure that this evening they might receive the diplomas that make them Samoan graduate nurses. I am very proud of them.

We are apt to think of a graduation as an end. A graduation such as this is only a beginning. These graduates are like travelers stopping to rest on a mountain trail, looking back over the steep way they have come. To-morrow they start on again and the way before them is still long and hard. Your good wishes I know they have, but I am going to ask you for more than that. I am asking your help for them, your encouragement, and your cooperation. The medical officers and the Navy nurses have done their best to teach them the things they must know if they are to realize their desire—service to their people, to you.

The Samoan people pay the taxes that help to support the Samoan Hospital and the training school. It is your hospital and your training school. So is the district nurse yours. How much or how little she can do for you depends largely on your cooperation. You have learned to think of the district nurse as one who comes to give help when you are ill, to dress a wound, or to give medicine. I hope you can learn also to think of her as one who comes to your village to help prevent sickness as well as to help cure sickness.

We have a proverb in the United States that says, "An ounce of prevention is worth a pound of cure." Medical science to-day is studying the causes of disease as earnestly as it is studying the remedies for disease. When we know what causes a thing to happen, we

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<sup>1</sup> Introductory remarks made at the graduation ceremony for the native nurses in Samoa, June 7, 1929.

can often prevent it from happening. We all know that fire burns, so we are careful to keep little children away from fire. Those of us who know that flies and mosquitoes carry disease are as careful to keep the flies and mosquitoes from the little child as we are to keep the child from the fire.

During the past year the senior medical officer has taught these nurses many things about the causes of the diseases that are prevalent in Samoa, and many things that can be done to prevent the spread of these diseases. These things this graduating class will try to explain to you when they go to your villages. This is the ounce of prevention that they carry with them.

I think of that ounce of prevention as seed. You all know the parable of the sower. As these nurses go among you, we expect them to sow the seed of prevention of such diseases as tuberculosis, typhoid fever, dysentery, yaws, and filariasis. Where the people are not willing to learn, not willing to help the nurse by cooperation, this seed will die as did the seed that fell upon stony places. But wherever the people are eager to learn, eager to help prevent disease, the nurses' teaching will be like the seed that fell on good ground and sprang up and bore fruit an hundredfold.

I spoke of this as the twelfth graduating class, for though the training school was founded in 1914 and the first class graduated in 1916, there have been two years since without graduations.

The first Navy nurse to be superintendent of the training school was Miss Humphrey. Some of you remember her. She never lost her interest in the Samoan nurses and corresponded with some of her old pupils until her death a year ago.

One of the members of that first class, who started her training under Miss Humphrey 15 years ago, was Pepe, our first Samoan chief nurse. Pepe has seen the training school grow from that first class of 3 to its present size, 30 student nurses. She has always been the wise guide and friend of the Samoan nurses and the loyal counselor and coworker of the Navy nurses. You have reason to be proud of Pepe, a pioneer among those Samoan women who are working for the health, education, and happiness of the Samoan people.

Thirty-four nurses have graduated from the training school and two graduates have died. Lusa, who graduated in 1920, died of tuberculosis in 1922 after a few months' illness. Seeseei, whom we all hold in loving memory, contracted typhoid fever from a child she nursed and died just before last Christmas Day. Both of these splendid nurses died as they had lived, in the service of their people. Both died of diseases that the Samoan people, working with the health department, can do much to prevent.

Marriage has greatly reduced the ranks of the district nurses. Only 11 are still in the service of the health department. There should be 25, and I hope that in a few years there will be that many.

If any of you have daughters who are ambitious to study nursing, I hope you encourage that ambition. If they enter the training school, we will do our best to help them to become healthy, happy, and useful women.

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#### NATIVE NURSES IN GUAM<sup>1</sup>

By HANNAH M. WORKMAN, Chief Nurse, United States Navy

It gives me great pleasure to call your attention to the first graduating ceremony for the native nurses. Not the first class, however, as the first class graduated in 1910 and there has been a graduating class each year since, to whom diplomas and pins have been given. To date there are 61 graduate nurses in Guam.

This is the first time that all of the graduates have been called together and we have done it not only to pay honor to the present graduating class but to pay our tribute of respect to all the Guam nurses and to call to the attention of the people the fact that there is a good school of nursing in their midst.

To the people of Guam the hospital is thought of as a place to come for relief from pain, to receive treatment, or to be made well. It is rarely thought of as a school for young women or an institution of learning.

To the young women who come to us for training because they wish to learn how to care for the sick it is a place of difficult schooling, and the diplomas and pins they receive are not easily won. Many tears are shed and discouragements overcome, and there are long weary hours of night duty which must be lived through. The training is hard and exacting. The medical staff holds the nurses to as high a standard of achievement and responsibility as the nurses are capable of attaining.

The history of the school and hospital shows a steady progress. In the early years of its life the native nurses acted more as maids and helpers to the staff of navy nurses than as nurses. To-day the native nurses are capable of taking orders from the doctors, carrying out treatments, taking charge of wards, and teaching younger pupils. Each year more and greater responsibility is laid upon their shoulders and they are responding gallantly to their duties. Since more responsibility has been laid on them the course of training has been

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<sup>1</sup> Introductory remarks made at the graduation ceremony for the native nurses in Guam, April, 1929.

lengthened so that the graduating class to whom you are paying respect to-day has been in training three years.

Because there is little or no nursing in the homes, the nurses petitioned the governor, through their commanding officer, to be permitted to remain on indefinitely at the hospital so that there might be for all time a very efficient group of nurses at the hospital, and the nurses might continue in the work upon which they had spent so much time and energy perfecting themselves. The governor has been pleased to grant this request. We can now hold up to the people of Guam a very worth while school for any young woman who has the qualifications and the grit and perseverance to try to become a nurse and so become a valuable person on the island.

To the nurses and graduating class, I have nothing but praise to give. To the people of Guam—you all know these nurses and have from time to time been ministered to, very efficiently by them. Through me, the nurses wish to thank the governor and the hospital staff for their continued interest in their progress and development. I ask the people of Guam to give more attention and kindlier thoughts to the nurses. They mean much to you in sickness and in health.

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## PSYCHOLOGY FOR NURSES<sup>1</sup>

### SENSATION

Sensation is a response; it does not come to us but it is aroused in us by the stimulus. It may be described as a mental state aroused in an animated organism by some exciting cause.

The purpose of sensation is to put the self in knowing contact with the outer environment. It is excited by the external stimulus. Without the brain response, there is apparently no conscious sensation, so that the activity of the sense organ and sensory nerve is preliminary to the response of the brain to the external stimulus.

A sensation requires time. There is only one thing that a sense organ always contains, and that is the termination of a sensory nerve. The different senses answer to qualitatively different forms of sensibility. Each sense has an object of its own and evokes a state of consciousness possessed of a distinct quality. It also has a highly specialized organ.

The object of taste is that quality by reason of which soluble substances are called sapid. The proper pleasure of taste is sweetness; its proper pain, bitterness. Smell is stimulated by odorous particles

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<sup>1</sup> This is the third and concluding number of a series of notes made by the nurses of the United States naval hospital, Norfolk, Va., and of the Pharmacist's Mates' School, Portsmouth, Va., from a course of lectures delivered before them by Dr. E. G. Fleming, associate professor of psychology at William and Mary College.

emitted from volatile substances and is closely allied with taste. Sensations of smell are important as premonitory signs of future experience.

Touch embraces various classes of feelings quite different from each other; organic sensations, sensations of temperature, touch proper, and muscular feelings. The organic sensation gives us information concerning the condition of the organism and serves as guardians of our health. Sensations of temperature are relative to our bodily heat. The sensations of passive touch are caused by pressure; muscular sensations constitute what is called active touch. through them we appreciate resistance.

Hearing is aroused by vibratory movements transmitted through the air. Its object is sound, musical and nonmusical, articular and inarticular. Sounds readily serve as signs because they can be retained in memory and associated with other mental states.

The formal object of light is colored surface. It is stimulated by other vibrations. Vision possesses power of delicate discrimination and great vividness. It is the avenue to the highest æsthetic enjoyment.

Our knowledge is relative in the sense that it is limited by the number and range of our faculties; also it is in this way that objects are known only in relation to sensation. This relativity does not destroy the worth and validity of our knowledge.

#### ATTENTION

Attention is exploratory and interrogative. In becoming attentive we pass into an attitude of inquiry and expectancy. It is also selective since it fixes itself upon some things and disregards others.

#### THE STIMULUS OR WHAT ATTRACTS ATTENTION

Interest begets attention. Attention increases pleasure or pain and tends, also, to arouse interest in an object. The range of attention is limited as well as its duration. We can not concentrate on many things. A teacher will do well to take this into account; then he will not be too exacting or try to force attention. Fatigue is unfavorable to attention.

#### SHIFTING OF ATTENTION

Distraction is the bane of the mind. It prevents us from making clear and accurate observation. When simply reading, the eye is governed by a definite interest and thus moves consecutively along with the series of words instead of shifting irregularly about the page.

### SUSTAINED ATTENTION

Attention intensifies the mental state toward which it is directed. Attention clarifies the object and renders it more distinct. Expectant attention diminishes the reaction-time. Attention requires considerable effort and is, therefore, difficult to maintain. It is helped by the attractiveness of the object and by the extrinsic motives that influence the will. It is mobile and variable and requires the influx of new energy to keep it at a high pitch. Even with such assistance it flows in waves rather than in a level stream. For, on the whole, we must admit that we do not know exactly what the focusing of attention can mean in brain terms.

### INTELLIGENCE

The study of man is most interesting, for man is an intelligent animal by nature, due to his native constitution. Intelligence is not general ability but a distinct faculty. Animals are devoid of reason and it is this fact which constitutes the enormous chasm that separates the brute from the rational being. The animal also is incapable of rational notions and is incapable of rational speech. It possesses no inventiveness and can learn only in a limited way by association. It is only man who is able to say "I" and to fully realize that he is the source of his activities. From this follows certain moral consequences. Only man is a person; only he possesses rights and is responsible for his actions.

### INTELLIGENCE TESTS

Brightness or dullness can also be measured by the intelligence quotient, which from its frequent usage is spoken of or abbreviated to "I. Q." In other words, it is the mental age divided by the chronological. It tells the mental age of an individual's intellectual level at a given time and the intelligence quotient tells how fast he has progressed. Or it actually furnishes a fairly accurate estimate of the individual's intelligence. Many group tests are made, particularly in schools. There are limitations, however, in these tests, as many men whose mental age is below ten, according to "Binet tests," have, nevertheless, steady jobs and thrive in a simple environment.

### SPECIAL APTITUDES

A special aptitude is a specific responsiveness to a certain kind of stimulus or object. Intelligence is of course quite different from instinct, in that it does not consist in ready-made native reactions. Special aptitudes run in families. Musicians may be found in several

generations. Many have special liking for it acquired by heredity. However, children of the same family may show ineradicable differences from one another in such abilities.

#### INTELLIGENCE AND THE BRAIN

The human brain, when it reaches maturity, exceeds that of all the lower animals in the richness of its convolutions. There is no evidence that the size of the brain or of the head is necessarily connected with the actual or potential intelligence. After 30 the brain begins to lose its plasticity. When examined microscopically the cortex shows difference of structure in its different parts and to these structural differences probably correspond differences of function. There is some probability that the special aptitudes are related to special parts of the cortex, though it must be admitted that few aptitudes have as yet been localized.

#### LEARNING AND HABIT FORMATION

Animals and humans are endowed with native traits or instincts to which they respond in a regular way. In addition, they are endowed with the power to acquire traits. It is these acquisitions that constitute learning and habit. All knowledge is acquired, the whole stock of ideas, as well as motor skill. These are modified responses of native reactions. Most motor acts that are acquired are based upon the reflexes. They are modified reflexes, and exercise strengthens them; it causes them to be fixed if variable.

A reflex may be attached to a new stimulus that ordinarily would not cause it. This is called a substitute stimulus. It gives us control to a certain extent over some of the reflexes. We can wink our eye at will or control other movements of the reflexes without regard to the regular stimulus. The power to control responses also gives us power to omit responses even if a natural stimulus is present. Holding the breath, keeping the eyes wide open in spite of the tendency to wink, and many similar instances of control over reflexes are cases of detachment of a native reaction from its natural stimulus.

The substitute response is another modification to be placed alongside of the substitute stimulus. In this case a natural stimulus calls out a motor response different from its natural response. Thus in the motor reactions we have fixation, substitute stimulus, substitute response, and the combination of reflex movements into larger coordinations.

In these ways, by strengthening, fixing, and combining movements and by new attachments and detachments between stimulus and response the instinctive motor activity of the baby passes over into the skilled and habitual movements of the adult.

In the sphere of impulse and emotion we have much the same modifications as in the motor stimulus; that is, fixation, substitute emotion, substitute response, and a combination of all of these. The modification of these processes constitutes learning.

#### ANIMAL LEARNING

In animal learning we find modified reflexes in response to stimulus. The elimination of response occurs most quickly when the response brings punishment. Elimination occurs more slowly when the response brings failure in reaching a goal to which the animal is tending. Animals learn by trial and error and not by reasoning or observing.

#### HUMAN LEARNING

All the forms of learning displayed by the animal are present in the human. He learns by trial and error. Negative adaptations are important but the great superiority of human learning over animal learning is in observation. Man has a greater control over his impulses and thus saves time and energy by observing and thinking.

#### LEARNING OF COMPLEX PRACTICAL PERFORMANCES

A student of telegraphy was tested as an illustration, and the number of letters sent or received per minute was taken as the measure of his proficiency. The number increased in the first few weeks until it reached a point which was the limit of what the nerves and muscles of this individual could perform. The student remained at this point for a considerable length of time until finally he found his curve of efficiency rapidly going up, and at last it reached a point where it again tapered off into a level. Such a flat stretch in a practice curve, followed by a second rise—such a period of little or no improvement, followed by rapid improvement—is called a "plateau." Thus he progresses from letter habit to word habit and finally to phrase habit where he has now reached the higher units of reactions. In reaching the higher units of reaction, there is the overlapping of different reactions, a species of doing two or more things at once. The telegraphing of word habits overlap each other, the beginner starting with the alphabet and proceeding gradually to the higher units. However, in learning to talk or read the process goes the other way. The child understands spoken words and phrases and can be taught better by beginning with whole words than by having them broken up into their elementary sounds. Continued repetition of a performance does not necessarily make it perfect or give it a high degree of skill. It is necessary that the



performance be measured and put before the learner's eyes so that he can observe his rate of progress. In other words, we need a strong incentive to attain our highest efficiency.

#### HABIT

Habit is a fixed response. If a new situation arises, the new response is exploratory and tentative, variable, slow, and uncertain, while habit is fixed and definite, regular, fairly quick, and accurate. To break a habit, a counterhabit must be formed.

#### MEMORY

Memory is the power by which past experiences are retained, recalled, and recognized. It is our mental treasury. Without memory, there could be no learning and no acquiring of knowledge. The mere retention of past experiences, however, is not sufficient; we must be able to recall those experiences when needed. This latter phase of memory we call recollection. The excellence of our memory is measured by the facility of acquiring facts, the tenacity of retention, and the readiness of reproduction. Our daily experiences are constantly proving the unreliability of our memory.

#### ECONOMY OF MEMORIZING

Greater economy in memorizing is found by first observing the relationships and significant facts and by attempting to recite the lesson, prompting oneself and verifying the recitation by reference to the paper. Recitation has the advantage of stimulating the mind and it is more satisfying. It is also found that space repetitions are more satisfactory than unspaced or prolonged effort; that it is better in memorizing long lessons to divide them into sections, learning each section separately. Animals learn by doing, humans by doing and observing. The will to learn is sometimes important, as a directive tendency, to steer doing and observing into proper channels, but committing to memory consists of reactions that occur without any view to future remembering.

What we have learned is not retained by any process or activity. The learned reaction is in a state of rest and does not become active until some stimulus arouses it. However, the continuation of rest over a long period of time may cause the once learned reaction to be lost. Forgetting is slower when the material has been learned with all its relationships and connections.

Recall generally comes about through a stimulus previously linked with the response. Difficulties in recall occur through some interference to the response, even though the proper stimulus may have been given, such as emotion, fear, self-consciousness, etc.

Recognition is easier than recall. At its minimum, it is simply a feeling of familiarity with the object. Recognition is a form of learned response, depending on previous reaction to the object recognized. We are able to identify memories either with the present or the past.

#### ASSOCIATION AND MENTAL IMAGERY

Recall is most important in thinking and acting. Using the term "recall" broadly, we say that any previously learned reaction may be recalled. Learned reactions are recalled in writing, typing, and speaking. Observed facts can be recalled and this is the human form of recall. In animals, learned movements are recalled, but there is no clear evidence of the recall of observed facts. Sensory reactions are also recalled and these are known as mental images. These mental pictures vary greatly as to their detail, depending upon the individual. Mental images have much less detail than the original, they are not steady and are less enjoyable and satisfying than the actual sensation. The mental image gives no new facts that were not observed at the time the image was formed. Images taken for real things are common in some forms of mental disorder. Such false sensations are called hallucinations.

#### ASSOCIATIVE PROCESSES

Mental processes that depend on recall are called "associative processes." Where the mental processes that steer the recall depend only upon an idle mood, it is called "free association." Revery is an example of this association. One thought serves to recall another which in turn recalls a further thought. These facts are recalled one at a time. The factors of advantage in recall, that cause one response rather than another to occur, are the frequency with which the fact has occurred; the recency with which it has occurred; and the intensity with which it has occurred, also the state of the subject's mind. These factors are sometimes used in the examination of criminals.

The second associative process is called "controlled association" which occurs when some definite interest or purpose steers the associative processes. This enters largely into mental work. Like every other faculty, the memory must be built up by exercise and proper use. A good memory is laboriously acquired, and even the poorest memory may be strengthened by systematic effort.

#### IMAGINATION, WILL, AND PERSONALITY

The previous lectures on instinct, emotion, sensation, reasoning, etc., have led up to one word, "personality," and now, in considering imagination and will, it is found that they are so closely associated with personality that one can not be considered without the other.

Imagination is mental as distinguished from motor manipulation, whereas reasoning is a process of mental as distinguished from motor exploration. Imagination is like reasoning in being a mental reaction, but differs in being manipulation rather than exploration. The materials manipulated in imagination are usually facts previously perceived at different times, and, to be available for mental manipulation, they must be recalled and rearranged or combined to invent a different object, as a centaur is composed of man and horse.

Imagination and invention mean very much the same mental process, though imagination is building air castles and invention is putting the thought into concrete form; but it is an imaginative person who is an inventor.

In imagination, as in all forms of psychology, the fundamental question is, What is the stimulus and what the response? The following is a chart of imagination:

Stimulus	Response	End result
Facts perceived at the moment or recalled from past perception that are related or combined.	Mental manipulation...	Placing facts into new combinations or relationships.

Dreaming, whether awake or asleep, is free imagination. Day-dreaming does not have to check up with any standard so long as it satisfies the dreamer for the time being. It has no fixed aim and is apt to occur at moments of relaxation. Most individuals indulge in short intervals of day-dreaming but some types of mental cases carry it to such extremes that they withdraw entirely from society and live in a make-believe world of their own. Most desires or instincts are gratified in imagination. Free imagination starts in babyhood when the child learns to manipulate his toys, toys being the first stimulus, and managing the playthings the first response. In various forms of play all instincts and emotions are given outlet, but of all the instincts, it is the self-assertive tendency that comes most often in play. Competition used in most games and sports is one of the best outlets for self-assertiveness. Day-dreaming is a sort of play but more imaginative than other play, and there is no serious plan.

Controlled imagination differs from free imagination or day-dreaming in that it is directed and has a serious plan or the accomplishment of some goal. One who controls his imagination is "one who dreams, yet does not make dreams his master." Controlled imagination is a close parallel to reasoning, but imagination is more variable.

Worry, or the abuse of imagination, is a sort of substitute reaction taking the place of action when action is not possible. A mother

worries over her child being late, imaging all kinds of dangers; if she knew just where to go or what to do to find the child, she would do it, but not being able to act, she worries.

"Will" is planned action in spite of internal conflict and against external obstructions. No chapter in psychology offers more in the way of practical application than the chapter on will. How to get action from yourself or from others for whom you are responsible is a big problem. To arouse the will to act so that the most may be accomplished that one is capable of accomplishing, a definite purpose is the first requirement and without that one merely drifts. There should be a goal not too easy to reach without effort nor so distant that one meets discouragement. There is no better incentive than competition and developing the self-assertive movement. Economic or sex motive is also an incentive as when a young man's goal is marriage. Officers in the Army and Navy and managers of industrial enterprise find that when they develop healthful competition among their personnel, leaving the initiative to the men in respect to ways and means and looking to them for results, the men will respond by throwing themselves into the enterprise as if it were their own.

Initiative seems to be partly a matter of imagination and partly of will and a big factor in personality. The physician and others who treat nervous or neurotic cases have the problem of getting action from their patients. It is difficult to arouse their interest and make them "will to get well." So many patients have given up and seem to get pleasure from bemoaning their unfortunate condition. They need to be encouraged to attain the goal of health and accomplishment. The first necessity is to win the patient's confidence, after that use persuasion or suggestions to give him a new perspective in which weakness and ill health are seen to be small and unnecessary and health and achievement desirable and according to the nature of things. In some cases a countersuggestion succeeds by arousing the self-assertive tendency.

The distinction between voluntary and involuntary action has been a question in the courts throughout the ages. The court tries to determine whether an individual committed a crime with full will and intention; whether he did it in a sudden fit of anger which is impulsive rather than voluntary, or whether it was an accident and wholly involuntary. The most distinctly voluntary act occurs when two alternatives are thought of, and one of them must be chosen. Everyone in the organization of his life is called upon to make decisions, and whether the decisions are made in a good or a bad direction decides an individual's character.

Internal conflicts are overcome by decision while external resistance is overcome by effort. As long as a task is easy, there is no need

for special effort, but when obstructions are encountered it is then that the "indomitable will" is needed. Nothing is so characteristically "will" as the overcoming of resistance that checks progress toward a desired result.

"Personality" is what others think you are; "character" is what you are. Differences in personality are due to the following: First, physical make-up. The size of a person affects his attitude toward others and others toward him. A large man easily dominates, while the little fellow is apt to be self-assertive. Good features give a man poise and self-confidence. Second, intelligence. This is one of the greatest factors in developing personality. One who is slow in learning adapts himself poorly to others and is apt to become a recluse. He who has the mental ability to understand others and to see their point of view is one who leads. Criminals, as a rule, average low in intelligence. Third, temperament. Science has proven that fear or anger causes secretion from the adrenal glands which gives energy to the muscles and that an overactive thyroid gland causes an individual to be excitable and strenuous. The temperamental person is apt to be one whose adrenal or thyroid glands function freely. Fourth, achievement. The person whose efforts are successful, who achieves his desires, is one who has adjusted himself to society. One who fails in his undertakings has a sense of inferiority. Fifth, various drives. Some psychologists claim that the sex drive, or the urge for existence, influences all life from birth, but Morris's tests with rats proved that the hunger drive is stronger than the sex drive. Sixth, heredity. Though there are continual adjustments all through life, one's childhood is most important in developing personality. The thoughts and beliefs inherited from parents, neighborhood influences, the economic level in which one lives, national achievement, racial precedence, and education last through life. Seventh, instincts. It is found that instinctive tendencies differ in strength in different individuals. One is more assertive, one more motherly, one more gregarious, and one has a greater sense of humor than another. These are all important elements in personality.

Learning consists of adjustments and fixations, and defects in personality often develop when adjustments become necessary. One's personality is considered good or bad according to his ability to adjust himself to social environment. Some of the objectionable personalities are: First, those who depend on others and leave the brunt of the burden for others. Second, the "cry-baby" kind, who whine when things go wrong and try to explain that they are not to blame. Third, those dependent on authority, not on their own experiences. Fourth, the homosexual kind, those who stay at home and dislike the society of the opposite sex.

Society allows various responses according to age, and as an individual grows older society expects more of him. A child 2 years of age may take something which does not belong to him and be laughed at, but the same act by a child of 6 is punishable.

Most natural impulses are disapproved by society. Natural fear is considered cowardly, yet grief, which is a combination of love and fear, is approved. Shell shock, which during the World War was experienced by some of the finest men, was due to fear. Love, a natural impulse, is disapproved by society except in marriage. A normal response for the infant when some stimulus causes rage is for him to thrash with his hands and feet or fight, but as the child grows older he realizes that this is not socially approved and tries to adjust himself. Often an inadequate adjustment takes place, and the rage instinct causes a desire to destroy. This same instinct is often seen in adults.

Many undesirable activities are caused by suppressed impulses. Every stimulus brings a response, and if the response is thwarted, there must be an outlet. A man who is uncertain or fearful in business should take physical exercise and have a hobby. Inadequate adjustments of sex conditions often cause pyromania. Phobia is caused by repressed emotions. Maladjustments are often made, then excuses to cover them. This is rationalization. To correct a conflict, an individual should reason out the condition and face the true facts, then act accordingly. For instance, a girl in a small town who has been reared with all the conventions of society feels there is nothing for her to do at home, so she decides to go to New York. After living in the large city for some time, she realizes she has no way of meeting young men in the approved way, or even should she meet them, she has no place in which to entertain them, and desiring to marry and live a normal life, she reasons out conditions with the result that she returns to the small town. In learning to adjust one's life, it is found that social disapproval of one's acts often causes a feeling of fear or anger.

About 75 per cent of the people have some feeling of inferiority and in trying to adjust this feeling, one often enlarges a complex. Some of the primary causes of inferiority complexes are: Physical or general weakness; over or under size; undesirable moral tendencies; environment; poor home training and education. Lameness or blindness seldom cause an inferiority complex. The following symptoms are usually caused from an inferiority complex. Avoidance of others, an averting eye, aggressiveness, indulgence in random activity, and rationalization. A superiority complex is often an inferior complex.

In S. Fowler Wright's *Deluge*, an imaginative story of a flood caused by a general depression of the soil of Europe, he shows man

with all social conventions broken down. There were only a few men and women left and in their struggle for existence he brings out the three natural sources of conflict—rage, love, and fear.

Self is what a person knows about himself; what he wishes or plans for himself. The infant learns to distinguish self from other objects, then from other people, as he often has to assert himself with others. As an individual grows, he begins to enlarge self and includes other persons, things, social groups, ideas, and principles as "mine." Self expands to take in everything that is of interest to him. In expanding, one may expand in more than one direction. When different interests and instincts come into one's life, two or more personalities may develop, one for home and one for business. A man may be gentle and pleasant in his office but crabbed and disagreeable at home, or vice versa. "Doctor Jekyll and Mr. Hyde" is an extreme picture of a dual personality.

The subconscious mind is one of the most fascinating subjects because it seems uncanny. Psychology only considers facts as they are proven. In the first place, retention is unconscious. The host of memories that a person possesses is carried about with him unconsciously. Retention is the resting period, whereas consciousness is an active condition.

There are two kinds of unconscious activities. First, there are the physiological processes of digestion, liver and kidney secretion, etc. Second, there are the "secondarily automatic" processes, once conscious, now almost unconscious through frequent repetition, as walking or drumming with a pencil while puzzling over a problem. There is a general supposition that when a person tries to recall a name or to work out a problem and can not, and waits for a time or overnight, that the subconscious mind works while the individual sleeps or rests and the next morning it is perfectly clear. It is more probable that when the problem was first attacked, difficulty arose from false clues which held because of their "recency value," but after a rest he could start anew, free from interference. It is the same with motor acts. A good ball pitcher finds he has lost his usual form and can not recover, but after a rest has no trouble. It is hardly probable that his subconscious mind has been practicing pitching during the rest interval. It is more likely that a fresh start and the consequent disappearance of interferences have proven of value, rather than work that has been done during the interval of rest.

Life is activity, and to live means to engage in full activity. The will to live is in a sense unconscious, but since life is activity, any will to act is the will to live, so that we may perfectly well say that the will to live is always conscious whenever there is any conscious impulse or purpose.

Leslie, Marsden, Kemp, and Laird have made tests to classify individuals as extroverts and introverts. In an experiment by Marsden

it was found that introversion shows in children as young as 2 years. He took 56 children—31 boys and 25 girls—from 2 to 6 years of age. The test was made in a room with a screen across one end, behind which was an attendant with toys. The children were taken in, one at a time, and left. The introvert would stand and look, the extrovert would explore. If they did not look behind the screen a noise was made; the extrovert would immediately look, the introvert would listen. When asked by the attendant if they would like to see a duck swim, they would both be interested. There were 20 boxes in a corner, 10 with toy ducks and 10 without. The extrovert would examine one or two boxes hurriedly and if no ducks were found would say, "There are none here," the introvert would continue looking. The boxes were hard to open; the introvert would keep trying, the extrovert, after a few minutes of unsuccessful effort, would say, "I can't open; you open." The children were taken to a museum; the introvert would stand at one case and examine each article, the extrovert would rush around, then want to go home. Boys were found more extroverted, girls more introverted.

Kemp insists that introversion or extroversion are inherited tendencies. Laird's test proved that men are more extroverted and women more introverted. Men who have accomplished great works of thought have been the introverted type, those who have accomplished great works of action the extroverted type. The introvert blushes easily, avoids occasions to talk in public, prefers to work alone, takes up work which requires fine detail, hesitates to make decisions, depreciates his ability, is critical of others, does not care for many friends but is careful in selection, limits friends to own sex, has ups and downs in moods, energetic at times, easily hurt but outspoken himself, speaks the truth even though it hurts others, keeps in the background of social entertainments, hesitates to give advice, painstaking with person, room, etc., prefers chess to football, resents discipline and orders, selfish and unable to see others' points of view, effeminate if a man, and decidedly so if a woman. An extrovert is just the opposite. Most people show tendencies of both types and are known as ambroverts.

In the study of insane persons there is a wonderful opportunity to study personality. The various types of insanity are all extreme, maladjusted personalities, often caused by physical weakness. Realizing this, the treatment and method of handling mental cases has become more humane. Efforts are being made to readjust and to give curative and constructive treatment.

Freud, Jung, Janet, Morton Prince, and others have added much to mental adjustments or toward better adjustment of the conditions of life. Though a great deal has been accomplished in the study of personality, a real scientific analysis remains to be worked out.



## NOTES AND COMMENTS

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### LETTERS OF COMMENDATION

In accordance with the statement made in the preface of the **BULLETIN**, the Surgeon General of the Navy appointed a board to select the papers published in the **BULLETIN** during the year 1929 which it considered to be worthy of letters of commendation. As a result of the selections made by the board, letters of commendation have been sent to the officers named below for the papers which appear opposite their names:

Lieut. Commander P. W. Wilson, Medical Corps, United States Navy, Report of Malaria and Microfilaria Survey of 11,000 Laborers and 2,007 Children in Haiti.

Capt. E. F. DuBois, Medical Corps, United States Naval Reserve, Physiology of Respiration in Relationship to the Problems of Naval Medicine, Parts V and VI.

Lieut. (Junior Grade) C. M. Longstreth, Medical Corps, United States Navy, Maintenance of Equilibrium in Aviation.

Lieut. W. Dana, Medical Corps, United States Navy, Simplified Rebreather Procedure.

Lieut. (Junior Grade) A. Ickstadt, jr., Medical Corps, United States Navy, Physical Qualifications and Aeronautical Adaptability.

Lieut. Commander O. Wildman, Medical Corps, United States Navy, An Outbreak of Cerebrospinal Fever in Northern Haiti.

Capt. M. A. Stuart, Medical Corps, United States Navy, Tuberculosis, Parts I and II.

Lieut. Commander L. H. Williams, Lieut. Commander O. Wildman, Medical Corps, United States Navy, and Chief Pharmacist's Mate Lee F. Curtis, United States Navy, Amebiasis in Haiti.

Lieut. (Junior Grade) A. W. Loy, Medical Corps, United States Navy, Disqualifying Eye Muscle Imbalances in Aviation.

Lieut. Commander R. M. Choisser, Medical Corps, United States Navy, Pathology in the Tropics.

Lieut. C. M. Shaar, Medical Corps, United States Navy, Clinical Analysis of 100 Operations upon the Gall Bladder and Biliary Tract.

Lieut. Commander H. E. Ragle, Medical Corps, United States Navy, Coccidioidal Granuloma, with Report of a Case.

Lieut. Commander J. Harper, Medical Corps, United States Navy, Japanese Schistosomiasis.

**TWENTY-FIVE YEARS OF AMERICAN MEDICAL ACTIVITY ON THE  
ISTHMUS OF PANAMA**

In a paper-bound book of 75 pages Col. Weston P. Chamberlain, Medical Corps, United States Army, chief health officer of the Panama Canal, has recited a chapter of the history of preventive medicine which will doubtless always remain the story of one of its greatest triumphs. It is sad to think of the small number of persons who will have opportunity to read such a chapter. In the light of its monumental importance, the number of readers constitutes a ridiculous incongruity.

The booklet is a synopsis of the work of the health department of the Panama Canal during the quarter of a century following May 4, 1904, on which date the United States took over the property of the French Canal Co. It is dedicated to "Those who gave their lives that a canal might be built."

Few people realize how far the idea of a Panama Canal dates back. Plans and surveys for the construction were made repeatedly since the early part of the sixteenth century. For nearly four centuries white men had been crossing the Isthmus and adding to its reputation for disease and death. The appropriateness of the reputation was emphasized during the gold rush in 1849, during the building of the railroad in the fifties, and most spectacularly during the French activities in the eighties. Gorgas believed that over 2,000 white employees died from yellow fever in the eighties, when their number never exceeded 2,500 at any one time, and averaged only 1,600 for the period. Malaria caused a widespread chronic disability among the workers of all races. It has been estimated that at least 16,000 employees died from all causes during construction under the French régime, when the total force of employees averaged only 10,121.

By 1904, when American operations began, tropical disease control was in its infancy, but it had the advantage of the knowledge contributed by the brilliant series of studies by Smith, Manson, MacCallum, Ross, Grassi, Reed, and many others concerning the insect transmission of certain diseases.

"Armed with the magic wand of mosquito control, backed by an improved conception regarding the prevention of intestinal diseases, endowed by treaty with absolute sanitary jurisdiction over a wide area, and provided with almost unlimited funds, the authorities were in a position to cope effectively with the health situation."

Twenty-five years of sanitary work in Panama have emphasized the truth of the modern precept that public health is a purchasable commodity. The medical history of Panama up to the present has shown that a large part of the morbidity and mortality among white men in the Tropics formerly attributed to climate *per se* is in reality

due in great measure to other factors, such as isolation, tedium, nostalgia, venereal disease, alcoholic excess, poor municipal conditions, and, most important of all, "to infection with specific parasites whose invasion is now almost entirely preventable."

The control of mosquito-borne diseases has consisted of incessant attention to details coming under the general heads of sanitation of residence sections, protection of individuals by screens, and prevention of infection of mosquitoes by screening the sick and sterilizing them by a long follow-up treatment with quinine.

"Statements to the effect that malaria has been eradicated from the Canal Zone might conceivably be possible but this would require years of effort backed by millions of dollars; no attempt has been made to do this, the antimalarial efforts being confined to the more important towns and their environs."

Many weapons are being used in the antimalarial work. Prior to 1919 trained natives killed large numbers of adult *Anopheles* mosquitoes. At Gatun they were catching and destroying from 5,000 to 10,000 adults per month in the screened quarters of employees. But with the present drainage and oiling systems it has become so difficult to find any *Anopheles* mosquitoes that the practice of routine catching has been abandoned. The clearing of grass, weeds, and shrubs and the introduction of larvæ-destroying fish are now considered of less importance than formerly, and expenditures of money are concentrated on more valuable measures, such as draining and filling residual water sites and the spraying of heated fuel oil. Three times a month 25 miles of shore line of Miraflores Lake are treated with the special heated-oil method. (This method, as described by Dr. D. P. Curry in the Proceedings of the Medical Association of the Isthmian Canal Zone for 1927, is discussed in the BULLETIN, p. 425, April, 1929.)

The antimalarial work has brought about a sharp decline in admission rates for malaria. This was reduced from 821 admissions per 1,000 in 1906 to 16 per 1,000 in 1916. Deaths from malaria were reduced from 7.45 per 1,000 in 1906 to none per 1,000 in 1921.

Death rates from other diseases have been reduced in a like measure. At Colon deaths from all causes were reduced from 51 per 1,000 in 1906 to 13 per 1,000 in 1927. The present figure compares well with that for any city in the United States and extremely well with other tropical cities. The leading causes of death among canal employees during 1928 were pneumonia, syphilis, and tuberculosis, in the order named. Deaths from typhoid were reduced from 115 in 1907 to none in 1917 since which time the annual number has never exceeded five.

Hospital construction has advanced as admirably as the sanitary program. Hospitals such as the Gorgas (formerly Ancon), Corozal, Colon, and the Palo Seco Leper Colony are superb models of their kind.

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#### CANCER AS A PUBLIC-HEALTH PROBLEM

The cancer problem and the attitude of the medical profession and the public toward it have passed through an evolution during the last 20 years that has been accompanied by many important changes.

The present status of the problem was so well and so authoritatively discussed by Dr. James Ewing at the twenty-seventh annual conference of State health officers with the United States Public Health Service in June, 1929, that the address has perhaps initiated and stimulated public movements for cancer control in many parts of the United States. Doctor Ewing's paper is published in the August 30, 1929, issue of United States Public Health Service reports.

Because cancer is noninfectious and because, until recently, it was looked upon as an incurable and nonpreventable disease, it has entered the field of public-health problems slowly and tardily. Since 1910 improvements in diagnosis and treatment have largely removed the "incurable" and "nonpreventable" obstacles, and certain countries have devoted much public money and effort in an organized dealing with the situation. Sweden has been the leading nation in such movements and now maintains the finest cancer therapeutic institute in the world. In 1915 the Swedish Government purchased a large amount of radium and made mandatory the attendance of cancer patients at the Government institute. It pays the railroad fares of patients, and, in Stockholm, conducts a 100 per cent follow-up system. Norway and Denmark are following closely the program adopted by Sweden. The British Ministry of Health considered that the profession and public in England were very backward in meeting the cancer problem. The ministry wrote a public letter on the subject and instituted some important reforms which resulted in a large change of attitude in that country in recent years. Thirty grams of radium was obtained at a cost of \$2,500,000, and 10 centers for diagnosis and treatment were established.

In the United States, Massachusetts has taken the lead in this activity as it has in many other public-health endeavors. There is a special cancer service at the Massachusetts General Hospital and at the Philadelphia General Hospital to which all cancer patients coming to those hospitals are referred. In the city of Buffalo, referring of patients to the central cancer service is mandatory.

The diagnosis and treatment of cancer comprise a strict specialty in medicine. There are as many clinical entities in the various groups of cancer as there are in diseases outside of cancer, and although they all consist essentially of malignant proliferation of cells, they differ widely in etiology, clinical course, prognosis, and indications for treatment. The strongest argument in support of central cancer services is the scarcity of men competent to pass on questions of diagnosis and treatment, and the consequent need for central organizations of these men and certain equipment.

Doctor Ewing has the opinion that the problem of the ultimate nature of cancer is unsolvable in the present state of science.

There are conflicting opinions as to the wisdom of various plans of attack on the problem. One group believes that the greatest progress can be made by a study of the ultimate nature of cancer—fundamental cancer research. Doctor Ewing is not of this group. He feels that more can be accomplished at present by picking out the particular chronic irritants and combating them. A dissemination of knowledge of the causes and early signs of cancer may be of public benefit within certain limits. In some major forms of cancer it is impossible to make an early diagnosis. In some instances no cure can be effected even if an early diagnosis is made. The results of propaganda are obvious in breast cancer, but of less value in skin and oral cancer and least satisfactory in the uterine group.

The major forms of cancer occur in the stomach, uterus and ovaries, breast, rectum, and esophagus. Stomach cancer presents no early signs and is 100 per cent fatal. In rectal cancer the operative mortality has been about 50 per cent, and the recurrence percentage about 40. Operation offers improvement to only about 10 per cent and cure to about 5 per cent.

One of the most helpful contributions has been Broder's system of grading according to malignancy. In grade 4 it is fortunate that while recurrence is the rule, radiosensitivity is also the rule. In uterine growths, the greater the malignancy the better the prognosis because of the increase in radiosensitivity with malignancy. In grade 4 uterine growths 46 per cent cures are possible by radium, zero per cent by operation. The scope of operability has been progressively reduced in favor of radiation.

There is a real and great need for cancer hospitals and institutes where cancer specialists can decide on questions of treatment and carry out the decisions. When the status of cancer service is brought up to the highest possible standard there will be less excuse for the indifference and fear on the part of patients.

**THE PSYCHONEUROSES: WHAT THE GENERAL PRACTITIONER SHOULD KNOW AND DO**

At the seventy-second annual meeting of the Missouri State Medical Association Dr. Peter Bassoe sounded many points on the subject of the psychoneuroses which the general practitioner might advantageously keep in mind. The address appears in the August, 1929, number of the Journal of the Missouri State Medical Association.

As to the meaning of neurasthenia, Doctor Bassoe repeated his statement made before the Wisconsin State Medical Society in 1928, that—

The new ideas formulated by Van Deusen and Beard (in 1869) were most fruitful for many years, as they led physicians to understand that many nervous-symptom complexes could be explained by inquiring into the habits of work and play, the family situations, and mental conflicts of the patients. But when the ideas had become codified and standardized in the textbooks and physicians thought they had done their duty when they applied the label "neurasthenia" because it fitted the symptoms and then prescribed some of the drugs—electrotherapy or hydrotherapy recommended in the books—without going into a painstaking study of the dynamic factors in the individual case, then progress became retarded. In other words, when neurasthenia began to be considered a disease entity it deteriorated into a convenient wastebasket and encouraged superficiality and laziness. Into this basket are carelessly thrown cases of unrecognized organic diseases of all kinds, early tuberculosis, pernicious anemia, even Addison's disease, early paresis, mild dementia præcox, melancholia, and maniac-depressive insanity, just because the features of irritability, exhaustibility, and undue fatigue may superficially fit the term "neurasthenia." Thousands of cases wrongly remain in the basket and are rescued too late or never.

Physicians in America are quite awake to the importance of the psychoneuroses in their relation to general medicine; this was evidenced in the 1927 meeting of the American Medical Association, when numerous excellent papers on the subject were read. In one of these, by Groves B. Smith, it was stated that at least one-fourth of the patients admitted to the medical wards of the Henry Ford Hospital were in need of psychiatry, and, conversely, that of 100 consecutive cases of anxiety neuroses at that hospital, only 4 per cent were free from associated organic pathology. Smith pointed out how "emotional conflicts, infantile responses, and behavior, and unsatisfied sex strivings are seen masquerading as hyperthyroidism, cardiac disease, and as pelvic disease."

Bassoe believes that greater attention may be given to normal and abnormal psychology in the medical schools, but rather than advocate more courses in more subjects he favors the stimulation of the student's interest by allowing him to observe the importance attached by his teachers and attending hospital physicians to data supplied by the social-service departments. "This kind of practical psychology,

based on common sense and devoid of a special terminology, will remain with the student and serve him well when he has to do his work, both medical and social, independently."

General practitioners should realize how much understanding of a case may be gained by an approach along such lines as hereditary influences, environmental conditions in childhood and the patient's reaction to them, the sex life and attitude of the patient, existence of and causes of feelings of inferiority, and finally a physical examination which will inquire into so-called functional symptoms which may indicate the beginning of organic disease. Bassoe confesses his own guilt in having diagnosed as hysteria the early stages of brain tumor and multiple sclerosis.

The failure on the part of physicians to play the part of personal friend and confidant has driven thousands of persons to Christian Science and other cults.

In closing his paper Doctor Bassoe quotes from a paper read in 1925 by George K. Pratt, medical director of the Massachusetts Society for Mental Hygiene.

The hope of psychiatry lies in a keener knowledge of and a broader sympathy for mental troubles on the part of the general physician. Without his enlightened interest and active aid little, if anything, can be done. In every community the general practitioner is the public health leader, to whom the lay citizens look for advice and help. If this physician be backward or indifferent to these issues, then also the citizen grows apathetic and disinterested. If the physician is unfamiliar with the symptoms of early departures from mental health and by his attitude gives the impression that the patient's complaints are of little consequence or that because of their social rather than their physical significance they fail to come within the province of the medical man, how, then, are we to blame the layman for not being sensitive to the importance of this great task in preventive medicine?

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#### PRESENT CONCEPTION OF ESSENTIAL HYPERTENSION

Dr. A. S. Granger, writing in the Journal of the American Medical Association of September 14, 1929, asserts that essential hypertension is a condition characterized by a persistent systolic blood pressure of 145 millimeters of mercury, or over, and a left ventricular cardiac hypertrophy, without demonstrable cause, though the hypertension may exist in the early stages without the cardiac enlargement. There is no definite cause for this condition. The factors most concerned are heredity and vasomotor hyperirritability. Vascular lesions of the medulla, affecting the vasomotor center, probably may produce a rise in the systematic pressure, but there is no proof that a hypertension does not precede such lesions. Sclerotic changes in the afferent arterioles of the renal glomeruli are almost pathognomonic of essential

hypertension and are the most common pathologic finding. The height of the diastolic pressure is probably of greatest moment in determining the prognosis. The cause of death, in a series of patients with essential hypertension, was cardiac failure in 52 per cent, cerebral vascular accidents in 31.5 per cent, uremia in 5.5 per cent and intercurrent disease in 11 per cent. Treatment should be directed mainly toward a regulation of the life and habits of the individual, so as to promote rest, freedom from worry and aggravation, and moderate pleasurable exercise. Dietary restrictions are of use only in the obese, or when cardiac or renal incompetence occurs. Drugs have a very small field in this condition. A frank discussion of the ailment by the physician and the patient is advisable in most instances.

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#### PREVENTION OF DIABETIC DEATHS

In a public letter (June 12, 1929) to the public health commissioner of Massachusetts, Dr. Elliott P. Joslin has pointed out certain prominent features of the present status of diabetic death prevention. Death from diabetes in persons under the age of 20 has almost disappeared from Massachusetts, and in the age group 20-49 the diabetic mortality is now lower than at any time in this century.

The Metropolitan Life Insurance Co. has recently shown that of 1,044 fatal cases of diabetes reported to them in 1929, coma was responsible in 433 cases, or 41 per cent.

Diabetic coma is always preventable and nearly always curable, and it is evident that the diabetic death rate can be greatly reduced below its present level.

Diabetics go into coma carelessly when they break their diets and overeat; they go into coma as a result of negligence when in the course of an infection, either general like measles or local like a boil, they neglect to make the proper tests to determine whether they are using enough insulin; they go into coma ignorantly, because they stop their insulin when they cease to eat for one cause or another. The diabetic must never forget that when he stops eating food he begins eating himself, and so still requires insulin and often very much more insulin than before. He should know that an infection lowers the value of insulin and thus makes more insulin than usual a necessity.

Minor differences in the treatment of coma exist, but all agree that promptness in diagnosis is everything, and next to it comes energetic treatment at the earliest possible moment. If coma exists, the doctor must give up everything else until the patient comes out of it.

Doctor Joslin gives the following rules in the treatment of diabetic coma:



1. Insulin is usually required every half hour in 10 to 40 unit doses or more, varying with the severity of the symptoms, and if it is given intravenously it should be given subcutaneously at the same time.

2. Dehydration of the patient must be overcome by the subcutaneous injection of normal salt solution, and one can not rely on fluids given by mouth or rectum.

3. The heart is almost always weak and needs stimulation with caffeine sodiobenzoate,  $7\frac{1}{2}$  grains, and this may be given every hour if need be, for three or four doses.

4. With children and usually with adults the stomach is distended and unless evacuated prevents the subsequent retention of liquids, such as water, gruels, ginger ale, or the juice of two or three oranges; in other words, carbohydrates amounting to 50 grams. Therefore, gently wash out the stomach.

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#### THE RÔLE OF THE UROLOGIST IN GENERAL DIAGNOSIS

In a paper read by Dr. Herman L. Kretschmer before the Kansas City Academy of Medicine in January, 1928, and published in the July and August, 1929, numbers of the Illinois Medical Journal, a veritable monograph has been contributed on the subject of differential diagnosis problems in which the urologist may play a prominent rôle.

He cites numerous case histories in which urological investigation was required to differentiate between lesions of the urinary tract and many extraurinary tract conditions, among which are mentioned:

Typhoid fever, and urinary sepsis.

The question of presence of urinary-tract lesions in cases of hematuria accompanying malignant endocarditis.

Acute appendicitis and acute pyelitis.

Chronic cholecystitis and lesions of the right kidney.

Prolapse of liver and malignant disease of right kidney.

Malignant disease of the large intestine and malignant disease of the bladder.

Diverticulitis of large intestine rupturing into bladder and malignant disease of the bladder.

Pancreatic tumor and kidney tumor.

Pancreatic cyst and hydronephrosis.

Tabes and multiple sclerosis and lower genitourinary tract lesions.

Amyotrophic lateral sclerosis and papilloma of the bladder.

Priapism from leukemia and from some local lesion.

Enlarged spleen and left kidney lesions.

Pernicious anemia with cord degeneration and benign hypertrophy of prostate.

**SEASICKNESS**

A recent addition to the Oxford Loose-Leaf System of Medicine is a chapter on Seasickness and Car Sickness which has been ably written by Capt. C. S. Butler, Medical Corps, United States Navy. There is a brief but most interesting historical account, aptly illustrated by a reproduction of George Cruikshank's cartoon of 1835, "To Calais."

Under "etiology" the author supplies a clearer understanding of this by his explanation that finding one's "sea legs" is a matter of learning to compensate for and properly correct the original faulty interpretation of the pressures of endolymph in the semicircular canals.

He believes that treatment with depressant drugs should be reserved for "those extreme cases which are hopeless from the standpoint of ever learning the trick of being a good sailor." The widely advertised proprietary drugs consist chiefly of some depressant, chlorbutanol being the principal constituent of the well-known Mothersill's "remedy."

Dammert's method of belladonna inhalation should fall into disuse in time since it has no relation to the etiology of seasickness, and the limitations of belladonna in the treatment of seasickness have long been known.

The use of sodium nitrite gives some hope in selected cases, and it has been favorably reported on during 1928 from several sources. "Sodium nitrite depresses the vestibular responses and hence should aid in the relief of the affection."

Other well-known aids mentioned are laxatives, exercise, the mental attitude of the passenger, a position amidship in the fresh air and away from the noise and fumes of the engine room or galley.

For severe nausea and vomiting two or three glasses of warm water with sodium bicarbonate are recommended for the removal of mucous and bile regurgitated into the stomach.

For the "hopeless" cases, Girard (Jour. Am. Med. Assn., 1906, XLVI, 1925) has advised the hypodermic injection of one-one hundred and twentieth grain of atropine sulphate with one-sixtieth grain of strychnine sulphate taken either at the beginning of the voyage or during heavy weather and repeated if necessary twice at hourly intervals.

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**LEAGUE OF NATIONS CONFERENCE ON LABORATORY TESTS FOR SYPHILIS**

What is the status of laboratory tests for syphilis to-day? To find the answer to this question, the League of Nations health committee arranged a competitive conference last summer at the State Serum Institute in Copenhagen (May 21-June 4, 1928). The gen-

eral plan of the health committee was to have authors of different Wassermann and precipitation tests examine serums by means of their respective methods. Specimens of blood were collected by clinicians in medical centers such as London, Paris, and Berlin and sent by air mail to Copenhagen. The serums were then separated from the blood clots, divided into 15 different portions, and distributed to each worker or group of workers participating in the competition. After testing the specimens, the workers submitted records of their results in sealed envelopes to the secretary of the conference, to whom alone the clinical histories were available. The conference considered four requirements as basic for a desirable test for syphilis: (1) Practicability, (2) sensitiveness, (3) specificity, and (4) clear-cut reactions. It was found that of these methods which stood out in specificity, the Wassermann tests "picked up" 210 and 195 positive reactions, respectively; the Sachs-Georgi tests 208 and 254 positive reactions, respectively; and the Kahn test 305 positive reactions. One method exceeded the Kahn test in sensitiveness, namely, the Muller test, which obtained 317 positive reactions. As a result of the complexity of this test and the fact that antigen can be obtained only from one pharmaceutical house, this test was considered in its present form as lacking in practicability. The conference recommends the use of two methods and would for the present prefer that one of the methods should be a Bordet-Wassermann test. Some members, including R. L. Kahn, Ann Arbor, Mich. (*Journal A. M. A.*, August 3, 1929), did not concur in this view. Although apparently logical theoretically, this opinion does not appear to be borne out by fact. The Kahn test, for example, was checked at the conference, not with one Wassermann method but with seven. When the results were considered, this test, free from false reactions, gave a total of 305 positive reactions against 208 positive reactions given by the best of the Wassermann methods. Because of the fact that the Kahn test stood out in practicability, specificity, sensitiveness, and clear-cut reactions in the serum tests at Copenhagen, Kahn was invited by the League of Nations health committee to enter into a special competition with the Harrison-Wassermann method on tests with spinal fluids. The Wassermann test gave a total of 177 ++ and 63 + reactions, while the Kahn test gave a total of 223 ++ and 18 + reactions. Neither of the two tests gave false positive reactions in this series.

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#### YAWS—SYPHILIS RELATIONSHIP

Naval medical officers and other readers of the BULLETIN are probably familiar with the position of Capt. C. S. Butler, Medical Corps, United States Navy, on the question of the yaws-syphilis relationship.

Doctor Butler has contributed another article on the subject, this latest being a lecture delivered by him at Georgetown University Medical School, May 3, 1929, and published in the August, 1929, number of the *Annals of Internal Medicine*.

Doctor Butler's conception of yaws is the same as that of Thomas Sydenham and Jonathan Hutchinson. He describes it as an "epidemic nonvenereal syphilis transmitted innocently amongst primitive peoples and which under stone-age conditions of personal hygiene constitutes one of the exanthemata of childhood." He believes that treatment and civilized clothing and habits will change epidemic syphilis to venereal syphilis, or that "civilization syphilizes yaws."

"The paradox of an actively contagious condition disappearing from certain islands and countries while maintaining its full reign in near-by islands or adjacent countries in close communication with the first, finds its only logical and satisfactory explanation in the above assumption."

His idea of the origin of yaws in the West Indies is that the disease was brought to the slave-bearing fringe of Africa by Portuguese slave traders as venereal syphilis, and transported with the slaves to the West Indies in its modified or "yaws form."

Thomas Sydenham is quoted, who, in the seventeenth century, described yaws:

But to me it rather seems to have taken its rise from some nation of the Blacks upon the borders of Guinea, for I have been informed by several of our countrymen of great veracity, who lived in the Caribbee islands, that the slaves which are newly from Guinea, even before they land, and likewise those that live there, are afflicted with this disease, without having known an infected woman; so that it frequently seizes whole families, both men, women and children. And, as far as I can learn, this disease, which so frequently attacks these miserable people, does not at all differ from that we call the venereal disease, with respect to the symptoms, viz, the pains, ulcers, etc., allowing for the diversity of climates; tho' it goes under a very different name, for they entitle it the Yaws. Nor does their method of cure differ from ours, for in both cases a salivation raised by quicksilver carries off the disease; notwithstanding what we say here of the excellent virtue of gualacum and sarsaparilla in those places where they grow, which is judged to be nearly lost in their long passage to us.

The organisms found in lesions of yaws and of syphilis are still indistinguishable morphologically or by any other bacteriological means of identification.

The two conditions are increasingly recognized as having a similar etiology, immunology, clinical course, pathology, and treatment.

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#### PRESENT-DAY TREATMENT OF GONORRHEA IN MALE

Howard S. Jeck, New York (*Journal A. M. A.*, July 27, 1929), asserts that the present-day methods of treating gonorrhoea are still largely the methods of a decade ago. Comparatively few new drugs

and treatments have been added to the therapeutic armamentarium. Of the new remedies employed as urethral injections, acriflavine is the most prominent. Mercurochrome is of value in chronic posterior urethritis as an instillation. The older organic silver preparations, viz, mild silver protein and strong silver protein, have by no means been supplanted. Potassium permanganate is still used widely and there is no indication that it will be shelved in the near future. Very acute gonorrhoeal urethritis is best treated by omitting all local treatment. In the average case, sounds and the complement fixation test are better criteria of cure than the culture. Treatment of the acutely inflamed urethra by injections is safer than by forced irrigations. Prostatic massage should be performed neither too vigorously nor too often. The small meatus and the long prepuce are significant factors in a prolonged urethritis. Methenamine in uncomplicated gonorrhoeal urethritis is worse than useless. The value of vaccines is questionable. Given for their specific effect, they apparently exert a favorable influence in certain types of chronic gonorrhoea and the gonorrhoeal metastatic infections. Their employment to produce a foreign protein reaction is not without danger. The status of diathermy is not yet established. Some observers state that they have had brilliant results with it while others are seemingly not impressed by its virtues. The results of mercurochrome, metaphen, sodium iodide, diathermy, a proprietary sterile milk and autoserotherapy as tried out in the complications of gonorrhoea at Bellevue Hospital have been disappointing.

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#### PROBLEMS OF MECHANICAL REFRIGERATION

Several deaths which have occurred recently in Chicago have been attributed to poisoning by methyl chloride which leaked from refrigerating systems. These have received wide publicity and have caused apprehension even among the users of refrigerating equipment entirely unlike that to which the fatalities have been attributed. It is the purpose of this statement, authorized jointly by the Public Health Service, the Bureau of Standards, and the Bureau of Mines, to state the essential facts regarding this danger and to relieve any undue anxiety in the minds of those possessing household refrigerating systems.

All refrigerating systems in practical use depend for their operation upon the repeated gasification and condensation (sometimes by dissolving or "absorbing" in another substance) of a material which is technically called a "refrigerant." In most cases the refrigerant is confined under pressure in the refrigerating machine, and if it

escapes from the system, becomes a gas which mixes with the surrounding air.

For many years the gas ammonia was almost the only refrigerant used. For technical reasons, other refrigerants have more recently been introduced and are now extensively employed. Sulphur dioxide and methyl chloride are the most important of these.

None of the three refrigerants mentioned, ammonia, sulphur dioxide, or methyl chloride, can be breathed with impunity, but none are violent poisons when breathed for a short time in low concentrations. If the same amount of the three substances is considered, methyl chloride is the least poisonous of the three; but because their physiological effects are quite different it is hard to make a quantitative comparison. Sulphur dioxide and ammonia both have strong odors which are easily recognized and are so irritating that no one is likely to breathe much of them if escape is possible. Methyl chloride has a slight and rather pleasant odor, which probably would not awaken a sleeping person and might not be recognized by one who was awake. To this fact is to be attributed any greater hazard from methyl chloride than from other commonly used refrigerants.

Most of the trouble attributed to methyl chloride has occurred in connection with multiple refrigerating systems installed in apartment houses in which a single compressor delivers the refrigerant through tubes to the refrigerators in the several apartments. A large majority of the individual household refrigerators of the motor-driven ("electric") type now in use employ sulphur dioxide as the refrigerant. Nearly all, if not all, of the domestic refrigerators the operation of which depends upon supplying heat instead of mechanical compression use ammonia. This class includes a few electric refrigerators of unusual type and all of the gas-fired refrigerators. The escape of the refrigerant from the more commonly used household refrigerating systems would, therefore, be at once made evident by its odor.

Newspaper headlines and statements to the effect that the fatalities in Chicago were caused by "gas refrigeration" without doubt had reference only to the fact that refrigerants are gases. "Illuminating" or fuel gas was in no way involved.

The high volatility of all practicable refrigerants makes it quite improbable that enough of these substances could be retained in food stored in the refrigerator to be harmful.

Methods for eliminating the danger from methyl chloride systems are being studied. It would be premature to say whether the end will be accomplished by replacing methyl chloride entirely by other refrigerants, by adding something which will give the refrigerant a sufficiently powerful odor, or by so improving the mechanical con-

struction of the equipment that leakage will not occur where the gas might enter rooms in which people live.

It should be recognized that the number of serious accidents from household refrigerating systems has been small in comparison with the number of such systems in use, and improvements may be expected which will much reduce the small hazard that does exist.

Doctors Kegel, McNally, and Pope, of Chicago, reported in the *Journal of the American Medical Association* of August 3, 1929, that the narcotic properties of methyl chloride have been recognized for more than 50 years. Its toxicity is given as one-fourth that of chloroform. Recent carefully controlled studies in the United States Bureau of Mines show that exposures of from 10 to 12 hours to concentrations of the gas as low as 0.12 or 0.15 per cent are sufficient to produce death in guinea pigs and that such exposure results in characteristic pathologic changes in the experimental animals. The authors reviewed the literature which showed 43 reported cases of poisoning with one death from methyl chloride incidental to its use in ice machines and refrigerators. During the past year there have been reported in Chicago 29 cases of poisoning by commercial methyl chloride gas, resulting in 10 deaths. Poisoning with commercial methyl chloride gas produces a characteristic clinical picture, of which the outstanding symptoms are drowsiness, mental confusion, coma, nausea, vomiting, and in severe cases convulsions. The temperature, pulse, and respiratory rate are all increased and anuria usually occurs. The blood picture is suggestive of a primary anemia, with practically no regeneration during the first week. Hemoglobin falls with the red count and there is a moderate leukocytosis. The blood pressure is usually decreased. Examination of the urine indicates transient acute nephritis. Formic acid was found when the test was made early. The sequelæ noted are suggestive of injury to nerve cells, followed by progressive degeneration. Human cases post-mortem showed practically the same pathologic changes as experimental animals killed by exposure to low concentrations of methyl chloride gas. All cases of methyl chloride poisoning reported in Chicago have occurred in kitchenette apartments, having multiple-unit refrigerator systems, and where a leak was discovered in the apartment unit.

#### TOBACCO SMOKING

In a series of 150 adult male smokers reported on by Wingate M. Johnson, Winston-Salem, N. C. (*Journal A. M. A.*, August 31, 1929), the systolic blood pressure was 128.23, and diastolic 78.87. In the same number of nonsmokers, the average systolic pressure was 129.64, the diastolic 79.23. The average age was practically the same, 42.63 years for the smokers, 42.41 for the nonsmokers. The weight of the smok-

ers was 164.44, of the nonsmokers 161.08. The height was the same. Of 60 fatal cases of angina pectoris in males, 42, or 70 per cent, were in smokers; 18, or 30 per cent in nonsmokers. As a control, of 1,000 adult males taken from telephone directories in five cities, 81.8 per cent were smokers. In a series of 20 individuals tested, the blood pressure after smoking showed no change in 5 but dropped in 15. The average fall in blood pressure after smoking for the whole group was 4.9 systolic, 3.4 diastolic. Johnson concludes from these data that tobacco smoking apparently has no permanent effect on the blood pressure. There is no foundation for the popular belief that smoking decreases the weight of an individual. It is doubtful whether tobacco plays a major part in the etiology of angina pectoris. The act of smoking, if it affects blood pressure at all, reduces it temporarily. The effect of tobacco smoking is chiefly local, exerted principally on the pharynx.

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#### THE CHEMICAL WARFARE SERVICE INVESTIGATION OF THE CLEVELAND CLINIC DISASTER

As a result of the fire and explosions which occurred at the Cleveland clinic May 15, 1929, causing about 125 deaths from the poison gases of X-ray film combustion, the Chemical Warfare Service has conducted an investigation into several different aspects of the disaster.

The board has recently published its report. The conclusions are that:

1. Fires from nitrocellulose film have been of frequent occurrence in the past.
2. Records of film fires show that casualties have resulted from toxic-gas poisoning, these casualties varying from slight incapacity to death.
3. Such fires may be started by a direct flame, glowing cigarette, hot wire, hot steam pipe, electric-light bulb, or, in general, by any source of heat which will raise the temperature of the film above 100° C.
4. No ignition resulted from contact of films with pieces of hot asbestos lagging from steam pipes carrying steam pressures up to at least 135 pounds per square inch, nor from an impinging jet of live steam from a pipe up to the same pressure continued for 15 minutes.
5. Storage of films over long periods of time at somewhat elevated temperatures makes the film more sensitive to decomposition.
6. The storage of films in paper envelopes materially decreases the rate of burning and the maximum temperature obtained. It also tends to produce a flameless combustion, and decreases the percentage of CO.



7. Depending upon the manner in which decomposition is initiated the combustion may be of two types—a flameless combustion giving rise to large volumes of dense smoke and fumes; or a flaming combustion which in the presence of an adequate supply of oxygen gives rise to very little smoke or fumes. Flameless combustion is more productive of deadly gases than flaming of the films.

8. The rapidity of decomposition above a critical temperature is extremely rapid, approaching the rate of combustion of gun-cotton. Small amounts of cellulose-nitrate films will decompose at 130° C. in a few hours, and at 160° C. in about one minute. Large amounts will decompose at lower temperatures.

9. The decomposition, once started, is accelerated by the catalytic action of the products of decomposition. The rise of temperature due to decomposition may itself cause ignition of the film and of the gaseous products given off.

10. There is sufficient oxygen in the composition of the film itself to support combustion after the same has begun.

11. The gases formed by the decomposition are inflammable, and when mixed with a suitable proportion of air are explosive.

12. The volume of gases given off by burning film is from 4 to 5 cubic feet per pound of film, calculated to ordinary temperatures and pressures. Some investigators have found as high as 9.4 cubic feet per pound of film.

13. The principal toxic gases resulting from nitrocellulose film are carbon monoxide and "nitrous fumes." By "nitrous fumes" are meant the poisonous oxides of nitrogen  $\text{NO}$ ,  $\text{NO}_2$ , and  $\text{N}_2\text{O}_4$ , the proportions of which vary with the conditions accompanying the decomposition. The percentage of other toxic gases present is considered negligible.

14. In general, when cellulose-nitrate films are decomposed with flameless combustion in a vented chamber in the ratio of 2 pounds of film per cubic foot of air space, the following constituents are found in the amounts given. None of these gases have found use in warfare as toxic agents. A small amount of hydrocyanic acid is formed, but the amount is negligible compared to the other toxic gases present.

15. Experimental data indicate the casualties at Cleveland could be classified as follows:

(1) Immediate deaths due to carbon monoxide, lack of oxygen, and nitrous fumes.

(2) Cases brought out unconscious from carbon monoxide poisoning that later recovered, only to develop lung œdema later from nitrous fumes.

(3) Cases that seemed but little affected at the time, but later developed lung œdema from nitrous fumes.

(4) Sequelæ and complications of the above. The nitrous fumes, including NO, NO<sub>2</sub>, and N<sub>2</sub>O<sub>4</sub>, produce many of the physiological effects encountered in the delayed deaths.

16. The toxicity of nitrous fumes is such that inhalation of 0.6 to 1 milligram per liter of air (0.029–0.049 per cent by volume, calculated as NO<sub>2</sub>) quickly causes death. Inhalation of even smaller quantities may cause delayed death. Carbon monoxide can not be breathed without danger in concentrations of more than 12.5 milligrams per liter (1 per cent by volume) for a period of more than four to six minutes. Camphor vapors have no toxic effects on rats up to a concentration of 30 milligrams per liter (0.47 per cent by volume).

17. Film fires may be extinguished by adequate automatic sprinklers, released at 155° F., and the amount of toxic gases liberated is materially reduced by the operation of automatic sprinklers.

18. Water-soaked film which has been in a vault and exposed to the action of automatic sprinklers can be recovered, washed, and is still of use as a case record. Used film no longer necessary as a record has a salvage value if returned to the manufacturers.

19. The size of vent for X-ray film storage rooms recommended by the National Fire Protection Association, of 140 square inches per 1,000 pounds of film is sufficient to carry off the fumes, and, in the absence of explosions, without the development of undue pressures.

20. Too much reliance should not be placed on the fireman's canister type of gas mask in film fires due to the high concentration of toxic gases which may be encountered and the possibility that there may not be enough oxygen to support life. Under such circumstances the oxygen helmet is the only certain protection.

21. In two experiments, animals placed outside the chamber and downwind from the film fire showed no effects, owing to the rapid dilution of the gases.

22. X-ray films made from cellulose acetate show little tendency to decomposition and are nonexplosive. They do not generate deadly gases, except those common to combustion, as carbon monoxide. This type of film is alleged to possess certain properties which render it not so satisfactory for photography as the nitrocellulose variety. Viewed from this angle the board made no investigation and submits no opinion upon the same.

**NOTE.**—The foregoing paragraphs apply only to developed film, since undeveloped film contains light sensitive silver bromide which deteriorates with age and the film becomes unserviceable. Hence, it is extremely unlikely that a sufficiently large amount of undeveloped film would accumulate in hospitals and other places to constitute a danger from fires.

**PHOTOGRAPHS OF MEDICAL DEPARTMENT ACTIVITIES**

The Bureau of Medicine and Surgery is desirous of keeping its photographic files as complete and up to date as possible and will welcome the receipt of unmounted prints of Medical Department establishments and activities.

All medical officers are invited to cooperate in this matter although the bureau can not be obligated in any expense connected with the production of the photographs.

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**DENTAL PROSTHESIS FOR VETERANS' BUREAU PATIENTS**

Upon request from the United States Veterans' Bureau it is desired to inform all medical and dental officers that there is no authority of law for furnishing Veterans' Bureau patients with dental prosthesis. Veterans' Bureau patients should, therefore, not be advised to seek such service through agencies of the Veterans' Bureau.

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**FIRST INTERNATIONAL CONGRESS ON MENTAL HYGIENE**

Progress is being made in the organization of the First International Congress on Mental Hygiene, to be held in Washington, D. C., May 5-10, 1930. Educators, psychiatrists, other physicians, public officials, social workers, industrialists and many others from all over the world are expected to be present when the congress convenes.

Herbert C. Hoover has honored the congress by accepting the position of honorary president. Already 26 countries are represented on the committee on organization, of which Dr. Arthur H. Ruggles, of Providence, R. I., is chairman. Dr. William A. White, of Washington, D. C., is president of the congress, and Clifford W. Beers is secretary-general. The congress is being sponsored by mental hygiene and related organizations in many countries.

Questions to be discussed at the congress will include the relations of mental hygiene to law, to hospitals, to education, industry, social work, delinquency, parenthood, and community problems. A world-wide view of mental hygiene progress will be given. The subject will be discussed also in specific application to the maladjustment problems of individuals, special attention being probably given to childhood, adolescence, and later youth. It is the contention of those promoting the congress that mental hygiene has to do with the conservation of mental health in general, not merely with nervous and mental diseases. The point of view of clinical diagnosis and treatment will be considered, as well as that of administration of institutions and agencies.

Basic expenses of the congress are being underwritten by the recently organized American Foundation for Mental Hygiene. Opportunity will be afforded for acquaintance among delegates of the various countries, and translations, together with other conveniences, will facilitate comprehension of all that may be said in unfamiliar languages. Administrative headquarters have been opened at 370 Seventh Avenue, New York City, where John R. Shillady, administrative secretary, is in charge. A membership fee of \$5 (including the proceedings) has been fixed.

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#### AMERICAN ASSOCIATION FOR THE STUDY OF GOITER

The executive council of the American Association for the Study of Goiter has announced a prize of \$300 and a medal of honor to be awarded to the author of the best essay based upon original research work on any phase of goiter, presented at the annual meeting of the association at Seattle in September, 1930.

Competing manuscripts must be in the hands of the corresponding secretary by July 4, 1930, so that the award committee will have sufficient time to thoroughly examine all data before making the award.

Full particulars of other regulations governing details of the award will be furnished on application by the secretary, Rose Dispensary Building, Terre Haute, Ind.

The American Association for the Study of Goiter hopes that this offer will stimulate valuable research work on the many phases of goiter, especially on its basic course.

## BOOK NOTICES

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Publishers submitting books for review are requested to address them as follows:

The Editor,  
UNITED STATES NAVAL MEDICAL BULLETIN,  
Bureau of Medicine and Surgery, Navy Department,  
Washington, D. C.  
(For review.)

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A HISTORY OF THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY, by P. M. Ashburn, Colonel, Medical Corps, U. S. Army, Author of "The Elements of Military Hygiene," with an introduction by Surgeon General Merritte W. Ireland. Houghton Mifflin Co., Boston, 1929.

There are several reasons why it is hoped that this book will be widely read by naval medical officers. It is good medical history. It is the special part of American medical history that will interest and entertain physicians whose life's work lies in military medicine. It provides for them something of an education in the problems that a military medical organization must deal with. Finally, it may inspire some one to write a long-needed but yet unwritten book—a history of the Medical Department of the Navy.

This is the first history of its kind written since that by Harvey Brown in 1873. Brown's book has been long out of print and practically inaccessible.

That Colonel Ashburn has done a splendid job in turning out this fine book, and that he has told a story we can acquaint ourselves with to advantage is well stated by Surgeon General Ireland in the introduction. It is evident that the words of General Ireland are quite as applicable to the Navy as to the Army:

\* \* \* He has produced such a book as I hoped to see, has told a story that is true, wholly free from exaggeration, documented and accurate, but not long drawn out or hard to read. It is my hope that every Regular and Reserve officer of the Medical Department will familiarize himself with this story, will set his face and his heart to the promotion of the splendid progress which the department has made with the growth of modern medicine. I hope that all will appreciate, imitate, and perpetuate the fine qualities of such men as Isaac Senter, James Mann, James Lovell, William Beaumont, George Suckley, Jonathan Letterman, and John K. Billings, who in less enlightened days and despite the lack of knowledge and equipment which we deem absolutely neces-

sary, were nevertheless men of light and leading in the department and performed services which we should delight to honor.

\* \* \* The achievements of a Beaumont, a Reed, or a Gorgas attract the attention of the world, but, of course, such men and such achievements are rare. Most Medical Department officers lead rather obscure lives, as do most of their confrères in civil life, yet we like to believe, and I do believe, after 37 years of Army life, that we are doing worth-while work, are useful to the service and the State, and that our usefulness is growing now as it has grown in the past.

Our lives contain as few regrets, perhaps, and as much of satisfaction as those of any group of men to be found anywhere; our story, while by no means entirely a matter for pride, is at least a story of honest effort, of continual striving, of unselfish service, of steady improvement, of very honorable and very great achievement, a story we should like for the world to know. I commend it to your attention.

In reading this book one learns incidentally much more than the medical history of the Army. One can not read it without absorbing a good deal about the history of the United States, the history of American medicine, the history of preventive medicine, the triumphs against yellow fever and malaria at Panama and Habana, and much of biographical interest about the men who played important rôles in the public health part of the drama of civilization during the last hundred years.

*PATHOGENIC MICROORGANISMS*, by *William Hallock Park, M. D., Professor of Bacteriology and Hygiene, University and Bellevue Hospital Medical College and Director of the Bureau of Laboratories of the Department of Health, New York City; Anna Wessels Williams, M. D., Assistant Director of the Bureau of Laboratories of the Department of Health; and Charles Krumwiede, M. D., Assistant Director of the Bureau of Laboratories, Associate Professor of Bacteriology and Hygiene in the University and Bellevue Hospital Medical College.* Ninth Edition. Lea and Febiger, Philadelphia, 1929. Price, \$6.50.

This book is certainly all that the name implies and a great deal more. The new ninth edition has been thoroughly revised and brought up to date with the latest information available concerning pathogenic organisms and bacteriological technique in general.

Several of the chapters, especially those dealing with Pyogenic cocci, the pneumococcus, etc., have been rewritten and the subject matter presented in an easily readable form. The sections on immunity and especially that dealing with immunization against diphtheria and scarlet fever have been revised and are well worth reading by any one interested in this important phase of the subject. The cardinal points concerning measles, yellow fever, undulant fever, and tularemia are also clearly presented and offer a vast amount of practical information, both for the student and busy practitioner.

Throughout the book, the common names for bacteria are retained, supplemented by the new terminology suggested by the Society of

**American Bacteriologists.** This feature will be best appreciated by those who are only more or less familiar with the old nomenclature.

The book is well bound, and printed on a high grade of paper. It consists of 819 pages with 216 engravings and 9 full-page plates which are exceptionally good. The book can be highly recommended as being strictly up to date and well arranged. It would be a valuable addition to the libraries of the student as a text and also to the practitioner as a ready reference.

**EXPERIMENTS AND OBSERVATIONS ON THE GASTRIC JUICE**, by *William Beaumont, M. D., Surgeon in the United States Army*, and a biographical essay by *Sir William Osler, A PIONEER AMERICAN PHYSIOLOGIST*. Harvard University Press, Cambridge, Mass. Price, \$3.

Perhaps no man in medicine has made better use of an opportunity to improve our knowledge of the physiology of digestion than William Beaumont. His classical experiments have stood the test of time and laid the foundation for our later day knowledge of digestion. The Harvard University Press has taken the original publication of Beaumont's and made a facsimile of the original edition. With this printing, as an introduction, they have included the address by Sir William Osler before the St. Louis Medical Society on October 4, 1902. Both of these manuscripts are too well known to need comment from a reviewer. The printing is well done and provides a copy of Doctor Beaumont's interesting work for the library of our younger medical men.

**OUTLINE OF PREVENTIVE MEDICINE**, prepared under the auspices of the Committee on Public Health Relations of the New York Academy of Medicine, Editorial Committee, *Frederic E. Sondern, Chas. Gordon Heyd, and E. H. L. Corwin*. Paul B. Hoeber (Inc.), New York, 1929. Price, \$5.

Into this comparatively small book has been compressed more information useful to the practitioner and medical student concerning preventive medicine than can be found in many of the larger textbooks on the subject. In many respects the information given is elementary, and is, therefore, the more valuable for those who have heretofore given little thought to the problems discussed.

This is not a textbook written by one man who has specialized in preventive medicine and public-health work. On the other hand, it is a collection of chapters by men of distinction in the various specialties of medicine and surgery who are well able to show the correlation which exists between their specialties and the public welfare.

As a book which stimulates interest in public-health work and points the way to more extensive study of this most important subject it may be highly commended.

TULAREMIA, HISTORY, PATHOLOGY, DIAGNOSIS AND TREATMENT, by *Walter M. Simpson, M. S., M. D., F. A. C. P., Director of the Diagnostic Laboratories, Miami Valley Hospital, Dayton, Ohio; Formerly Senior Instructor in Pathology, University of Michigan.* Foreword by *Edward Francis, Surgeon, United States Public Health Service.* Paul B. Hoeber, (Inc.), New York, 1929. Price, \$5.

This book is very appropriately dedicated to Edward Francis, and also, most fittingly, it contains as frontispieces a splendid photograph of Edward Francis and of George W. McCoy.

A monograph on tularemia written as excellently and authoritatively as this one should be unusually welcome at this time.

Certain peculiar features of tularemia have been responsible for the remarkable interest it has aroused in America during recent years. These features are ably touched upon in the foreword by Edward Francis and in the introduction and historical chapters.

The disease, elucidated entirely by American investigators, "has abruptly become a world-recognized new disease of man and has taken its place in the medical literature of every country."

Because the organism has a large variety of hosts, both animal and insect, Francis believes that its perpetuation is assured over an increasingly wide geographical distribution.

The alertness of the American physician is attested by the fact that the disease has been repeatedly and correctly diagnosed in 39 different States by many men who had not previously seen a case and whose knowledge of the condition was obtained solely from medical literature.

According to Francis "the certainty of diagnosis by agglutination in tularemia has no equal among other diseases. I do not know of any other disease in which our agglutination test will set the diagnosis right in so certain terms after so many years."

Tularemia can no longer be regarded as a rare disease. Although only 15 cases had been reported up to 1924, over 800 cases were recognized in the United States during the last four years. Sixty-one of these cases were discovered by Simpson in one community—Dayton, Ohio.

Tularemia occupies the unique place of being "the first American disease," and Victor C. Vaughan has characterized it as "a disease discovered by the United States Public Health Service." The story of the unravelling of the various phases of the problem by Francis, McCoy, Chapin, Wherry, Lamb, and others is one of the most fascinating chapters in medical history.

In praising this book, the reviewer repeats the words of Francis: "Simpson's pursuit of his subject is a model. Within the pages of his book he states the story of tularemia in a clear, complete, and authoritative manner."



The author is well known to many medical officers both through his excellent contributions to the *BULLETIN* and because he is a member of the Reserve Corps.

**THE ESSENTIALS OF MEDICAL DIAGNOSIS**, by *Sir Thomas Horder, Bart., K. C. V. O., M. D., F. R. C. P., Lond., Physician in Ordinary to the Prince of Wales; Physician to St. Bartholomew's Hospital, and A. E. Gow, M. D., F. R. C. P., Lond., Physician and Charge of Out-patients and Demonstrator of Practical Medicine at St. Bartholomew's Hospital.* Willam Wood & Co., New York, 1929. Price, \$5.

This manual, of 682 pages, is a fund of information on medical diagnosis.

After a preliminary discussion of history taking and the general principles of examination the authors take up each system separately, beginning with a discussion of the anatomical and physiological considerations involved. This is an especially valuable feature and one not usually found in a book which its authors call a manual.

Laboratory findings in various conditions are taken up in connection with the different symptoms or clinical entities. X ray and instrumental procedures and findings are briefly discussed. In the chapter on Diseases of the Blood, one wonders why the therapeutic test with liver and the reticulated cell count in pernicious anemia has been omitted.

The book as a whole is much more readable than most manuals, and, considering the wealth of material presented, this seems remarkable.

While the illustrations are not numerous they are well chosen and beautifully executed.

An appendix of tables of normal data concludes a book of much merit and one that should be of especial value to students and to those who are not constantly doing clinical work.

**RECENT ADVANCES IN CARDIOLOGY**, by *C. F. Terence East, M. A., M. D. (Oxon.), F. R. C. P. (Lond.), Junior Physician, King's College Hospital; Physician, Woolwich Memorial Hospital; Sometime Radcliffe Traveling Fellow, University College, Oxford, and C. W. Curtis Bain, M. C., M. B. (Oxon.), M. R. C. P. (Lond.), Assistant Physician, Harrogate Infirmary.* P. Blakiston's Son & Co., Philadelphia, 1929.

This is the best book that the reviewer has read on cardiology in recent years. Any one section is well worth the price of the book. The manner in which the arrhythmias are treated is excellent and clears up many controversial questions. The review of the literature has been complete and has been compiled in a very limited space without detracting from the value of the original article. The authors are to be commended on the sections dealing with cardiac failure, digitalis, and quinidine.

No one who attempts to practice cardiology or one who occasionally treats cardiac cases should be without this book. It can not be too highly recommended.

**ORTHOPEDIC SURGERY** by *Str Robert Jones, Bart., K. B. E., O. B., Ch. M. (Liverpool), F. R. C. S. (England, Ireland, and Edinburgh), F. A. C. S. (U. S. A.), Emeritus President British Orthopedic Association; Past President Association of Surgeons of Great Britain and Ireland; etc., and Robert W. Lovett, M. D., F. A. C. S., Professor of Orthopedic Surgery in Harvard University; Member of the International Surgical Society; etc., with the collaboration of Nathaniel Allison, M. D., F. A. C. S., Professor of Orthopedic Surgery, Harvard University; Frank R. Ober, M. D., Instructor in Orthopedic Surgery, Harvard University; and Harry Platt, M. D., M. S., F. R. C. S. (Eng.), Clinical Lecturer in Orthopedic Surgery, University of Manchester.* Second Edition. William Wood & Co., New York, 1929.

The scope of orthopedic surgery is constantly being widened. Pick up almost any textbook on the subject published before the war and you will find two-fifths of it devoted to tuberculosis of bones and joints, two-fifths given to infantile paralysis, and the small remainder used for brief mention of many minor lesions. In those days orthopedic surgery was of little interest to medical officers of the Navy.

Take the present volume as a contrast. We find less than one-sixth of the pages devoted to tuberculosis of the joints and one-twelfth to anterior poliomyelitis. Many of the chapters are of great importance to medical officers of the Navy, especially those on traumatic affections of joints, disabilities of the knee joint, stiffness of the joints, osteomyelitis, fractures, acquired deformities of the feet, and amputations.

This book is recommended for all naval hospitals. Every medical officer who is engaged in clinical work could read with advantage the sections on ischemic contracture, pyogenic infections of joints, and syphilis of the bones and joints, no matter what branch of the profession he practices.

**MINOR SURGERY**, by *Frederick Christopher, M. D., F. A. C. S., Associate in Surgery at Northwestern University Medical School; Attending Surgeon, Evanston Hospital, Evanston, Ill.* With a foreword by *Allen B. Kanavel, M. D., F. A. C. S., Professor of Surgery, Northwestern University Medical School.* W. B. Saunders Co., Philadelphia, 1929. Price, \$8.

In the foreword by Kanavel emphasis is placed upon the care with which the author has avoided including too much of major surgery in a textbook on minor surgery, an error frequently made by authors of books upon this subject. A close reading of this work bears this out, for Christopher seems to have struck the happy medium and to

have included just those things which the interne and the nonsurgical practitioner need to know in order to secure the best results in treating that large number of persons who suffer from minor surgical ailments. The chapter on the surgical interne will be especially valuable to the recent graduate in medicine, while the one on minor surgical technic contains much information which will be a help to all who practice medicine.

*THE TREATMENT OF FRACTURES*, by Lorenz Böhler, M. D., Chief Surgeon and Director of the Vienna Accident Hospital. Authorized English translation by M. E. Steinberg, M. S., M. D., of Portland, Oreg., Formerly Senior Officer on the Surgical Service of the United States Public Health Service Hospital, and Consultant Surgeon to the United States Veterans' Bureau at Portland, Oreg. Wilhelm, Maudrich, Vienna LX, Austria, 1929. Price osterr. S. 36.50.

This book is a valuable contribution to the literature of this subject. Treatment is stressed and diagnosis hardly dealt with. Since in practice the X ray has taken the place of diagnosis by physical examination, it is perhaps time that diagnosis be left out of our textbooks; at any rate, it is left out of this volume. Here the wide experience of one man is reduced by him to rules of practice. The section entitled "Fundamental Laws for the Treatment of Bone Fractures" and the author's views on Treatment for the Preservation of Function are most interesting and valuable. His enthusiasm for local anesthesia as an aid to reduction deserves careful consideration and should be given a fair trial by others. Although much of his traction apparatus differs in type from the apparatus in common use in this country, he describes its use in a way that will help to improve one's results in using any method of traction. He very clearly states the value of getting fracture patients up and about early but stresses the dangers of this so-called "ambulatory treatment" when splints and traction are not properly applied to maintain immobilization of the fragments at the time motion and use are begun. Fractures which are in some cases of poor prognosis at the present time, such as scaphoid, os calcis, both bones of the forearm, neck of the humerus, he seems to have placed in a more favorable group by slightly different methods than those described in American textbooks.

His splint for fracture of the clavicle seems to have some excellent reasons for its alleged efficacy in his hands. The section dealing with fractures of the hip in the aged seems of little help in the solution of this vexatious problem. This is not a book to replace our standard textbooks on fractures, but it is a valuable monograph that should greatly interest and perhaps influence surgeons, especially those interested in this surgical field.

**VARICOSE VEINS WITH SPECIAL REFERENCE TO THE INJECTION TREATMENT**, by *H. O. McPheeters, M. D., F. A. C. S., Director of the Varicose Veins and Ulcer Clinic, Minneapolis General Hospital; Attending Physician New Asbury and Fairview Hospitals; Associate Staff of Northwestern Hospital, Minneapolis.* F. A. Davis Co., Philadelphia, 1929.

Any tried and proven procedure in the treatment of disease which will reduce the "sick days" of the patient certainly is worthy of study. In this book Doctor McPheeters gives clearly and concisely the details of the injection treatment of varicose veins, as used in his clinic, and shows quite convincingly the improved results and lessened morbidity as a result of this treatment. The embryology and anatomy of the venous system is described briefly. There is a full discussion of the etiology and hemodynamics of varicose veins. There is a chapter on the direction of blood flow in varicose veins of the leg with illustrations of X-ray plates of lipiodol injections to confirm the theories. The author summarizes the various forms of operative procedures now generally used and directs attention to the general treatment of the patient which is often neglected in treating the local condition.

The indications for the injection treatment, the armentariums, the technic of the injections, the post-injection treatment, complications, and results are fully described. The chapter describing the pathology of the injected veins is particularly well written. It draws attention to the difference between the thrombus found as the result of the injection of the sclerosing solutions and that of an acute inflammatory process, especially with regard to the definite limitation and firm adherence of the former to the vein wall.

A long chapter is devoted to the treatment of varicose ulcer or *ulcus cruris*. This contains much valuable information with definite direction for ambulant treatment.

This book is recommended as a source of definite and authoritative information on all phases of the injection treatment of varicose veins and the treatment of their complications.

**STONE IN THE URINARY TRACT**, by *H. P. Winsbury White, M. B., Ch. B., Edin., F. R. C. S., Edin., F. R. C. S., Eng. Assistant Urological Surgeon, St. Paul's Hospital for Genito-Urinary and Skin Diseases; Assistant Surgeon, East London Hospital for Children; Urologist, St. John's Hospital, Lewisham; Consulting Urologist, Hammersmith Hospital; Professor, Royal College of Surgeons of England, 1925.* P. Blakiston's Son & Co., Philadelphia, 1929.

The author deals succinctly with all forms of stone in the urinary tract and all locations of such stones from the calyx of the kidney to the prepuce. Renal, ureteral, vesical, and urethral calculi are logically considered in that order, with descriptions of etiology, pathology, symptoms, diagnosis, and treatment. The book is tersely written

and affords in a limited space a vast amount of information on all phases of urinary lithiasis. Symptomatology and diagnosis are particularly well discussed, with separate headings for each symptom. Less space is devoted to treatment, with the exception of the treatment of vesical calculus. For this condition the author details the crushing operations very fully. Evidently he considers the indications for litholapaxy much broader than those generally accepted in America.

The book is excellently printed and profusely illustrated as the simplest and best method of emphasis. Another feature which is worthy of emulation is the printing of the key sentence or words of each paragraph in heavy type, thus showing the reader at a glance the important facts discussed therein.

There is a voluminous bibliography, affording reference to practically all articles on urinary calculus published from January, 1910, to June, 1928. The book thus recommends itself as a ready source of concise information and index of recent literature on urinary calculus.

**GYNECOLOGIC TECHNIC, SURGICAL AND MEDICAL**, by *Thomas H. Cherry, M. D., F. A. C. S., Professor of Gynecology, New York Post-Graduate School and Hospital; Director of Gynecology, Pan-American Hospital, New York City; Formerly Instructor in Operative Gynecology, New York Post-Graduate Medical School and Hospital; Member of American Medical Association; Pan-American Medical Association; American Urological Association; New York Academy of Medicine; Military Surgeons; Major, Medical Corps, United States Army Reserve, etc.* F. A. Davis Co., Philadelphia, 1929.

This is a carefully written book, which stands between a brief compendium of operative technic and the full discussive work of two or more volumes. From a long and full experience of gynecologic work the author has selected and presented the one standard method, based upon anatomy and pathology, which has given him the best results in the treatment of each condition. No discussion appears of the relative merits of various technics nor are essentials clouded by long historical dissertations.

In the section on operative technic each step of the operation is clearly and concisely described. The accompanying illustrations are fully and logically presented with no gap in their sequence. The steps may be easily followed in either text or illustrations alone and using them conjointly one obtains an excellent mental picture of the entire procedure.

The chapter on carcinoma of the uterus is especially well written and presents the latest information on the use of electrocoagulation and radiation therapy. In the section on medical technic the chapter dealing with diathermy in pelvic infections is very explicit. The

chapters on intestinal operations, vesical and ureter operations, suture and drainage material, anæsthesia and care of operative patients contains much valuable information that is useful in dealing with any surgical patient. This book is recommended especially as a valuable handbook for one who may have an occasional gynecologic patient.

**RECENT ADVANCES IN SURGERY**, by *W. Heneage Ogilvie, M. A., M. D., M. Ch., Oson., F. R. C. S. (Eng.), Assistant Surgeon, Guy's Hospital, and Lecturer in Clinical Surgery to Guy's Hospital Medical School; Examiner in Clinical Surgery, University of Oxford; etc.* Second Edition. P. Blakiston's Son & Co., Philadelphia, 1929.

This, the second edition of Ogilvie's work continues the high standard of excellence attained in the first edition. The principal and most valuable additions are the chapters dealing with X ray and radium therapy in malignant disease. A brief description is given of the theory and technique of radiation as well as the use of high-frequency currents in surgery. There are interesting comparisons of the methods of application of radiation in various British and continental clinics with charts showing the results attained. These results must be disappointing to anyone who looks upon radiation as the hailed panacea in treating cancer. In a summary of the relative position of radiation and surgery, the author brings clearly to our attention the advisability of the middle course of using both agents and decrys the practice of depending on either alone.

The subject matter of the book is well arranged, dealing logically with the surgery of the various systems. The tannic acid treatment of burns is very well described. Local and regional anesthesia receive excellent treatment. Spinal anesthesia is rather lightly discussed as being unsafe and unsatisfactory which seems unfair to this valuable contribution to surgical anesthesia. In the description of chest surgery, no mention is made of the work of Lilienthal on pulmonary tuberculosis or Keller's work in the treatment of chronic empyema.

After reading this book the reviewer asks the question, How recent are the advances mentioned? Certainly the description of paramedian, median, and gridiron incisions can not be classed as recent. On the other hand, the surgery of the sympathetic systems, phrenicotomy, and the use of insulin are among the later advances. The author thus presents a brief review of standard procedures and a resumé of the newer methods.

This book may be recommended as a compend of surgery which gives ready reference to advances and stimulates further reading.

**A GRAPHIC GUIDE TO ELEMENTARY SURGERY**, by *Professor Dr. Th. Naegeli, Bonn*. Translated by *J. Snowman, M. D., M. R. C. P.*, with introduction by *Dr. C. Garre, Bonn*. William Wood & Co., New York, 1929.

In this little volume of 202 pages, pictures, diagrammatic sketches, made more striking by colors, depict the anatomical and pathological structures in which the surgeon is interested. More space is given to these illustrations than to the printed text. The medical student should find in this comprehensive and yet easily read book a guide to the fundamentals of surgical practice. The author believes that what the student sees he is more apt to remember, and the emphasis placed upon the value of visual memory is here given a fine tryout. Surgical diseases and operations are not described, but the major anatomical relations and pathological conditions which must be visualized by the surgeon are simply and strikingly shown. This is a primer, a book for the beginner, for the medical student. The surgeon or physician who scans its pages will be interested, and if a teacher of surgical students, he might find the book of help in the class room. It might increase his ability to draw instructive diagrams on the blackboard to illustrate and drive home his lectures.

**A STUDY OF MASTURBATION AND THE PSYCHOSEXUAL LIFE**, by *John F. W. Meagher, M. D., F. A. C. P.*, *Neurologist to St. Mary's Hospital, Brooklyn; Neurologist to the Mary Immaculate Hospital, Jamaica; Consulting Psychiatrist to the Kings Park State Hospital; Consulting Neurologist to the Rockaway Beach Hospital; Ex-President of the Brooklyn Neurological Society; Member of the American Psychiatric Association, New York Neurological Society, etc.* Second Edition. William Wood & Co., New York, 1929. Price, \$2.

For those who are able to see in masturbation something that calls for a searching personality study, and something that can not be dismissed with mere admonitions, platitudes, or vague generalizations, this book should prove a distinct aid in an understanding of the problem.

Besides showing a profound psychological understanding of this subject, the author displays an abundance of common sense in his advice concerning the enlightenment of children by parents, physicians, and clergymen. The present trend toward frankness is doubtless breaking down much of the levity and the morbid fears that boys and girls associate with sex. A wide reading of this book will be exceedingly helpful in the development of frankness and in the adoption of a much more wholesome and sensible attitude than is usually encountered in America.

The author has well summed up his conclusions on the last page:

1. Infantile masturbation is practically universal; in adolescents, it is the rule with boys, and is very common in girls; in adulthood, it is more common in women than in men.

2. Physiologically, masturbation is not abnormal in young children, but the habit is always abnormal in adults, in whom it shows a psychosexual maldevelopment, or a regressive phenomenon.

3. The harm resulting from excessive indulgence in the habit is chiefly in the mental and moral spheres rather than in the physical sphere.

4. In the adolescent and in the adult, a cure of the habit is easiest where the traits and trends of the individual are predominantly good, where the wish to give up the habit is strong, and where numerous good incentives are actively present.

5. Sympathy and encouragement are great aids to the patient, whereas an antagonistic attitude, censure, and punishment are usually harmful.

6. The problem is more often a psychopathological one than a medical or surgical one.

**PRINCIPLES OF CHEMISTRY**, by *Joseph H. Roe, Ph. D., Professor of Chemistry, George Washington University Medical School; Lecturer in Chemistry, Central School of Nursing, Washington, D. C.; Captain, Sanitary Division, United States Medical Reserve.* Second edition. C. V. Mosby Co., St. Louis, 1929. Price, \$2.50.

This is a well presented, compact outline on elementary inorganic, organic, and physiological chemistry for the student having a limited number of hours for this subject. It is written in simple language intended not to confuse the beginner.

The "Questions for Study" following each chapter seem to cover the more important and basic facts of the chapter. The inclosing under one cover of both lecture and laboratory work seems appropriate for the class of student for which this book is intended.

The chapter on organic chemistry and its divisions for study is remarkably well presented, as are those on carbohydrates, proteins, fats, digestion, metabolism, and vitamins.

**MATERIA MEDICA FOR NURSES**, by *Edith P. Brodie, A. B., R. N., Director School of Nursing, Vanderbilt University, Nashville, Tenn.; Formerly Instructor in Materia Medica and Therapeutics, Washington University School of Nursing, St. Louis, Mo.* Third edition. C. V. Mosby Co., St. Louis, 1929. Price, \$2.

Miss Brodie has shown admirable skill in putting together in a small volume just the information that the nurse has need of on the subject of materia medica. It should be of particular value to student nurses, as the chapters are arranged to follow the order in which their subject matter enters into the experience of the student. Also, it may serve as a valuable ready reference for graduate nurses.

The newer preparations have been introduced into the classification of drugs which appeared in previous editions, and the information on medicinal foods and biological products has been included in a thoroughly up-to-date manner.

The book is especially to be commended because it includes only the drugs of common use and shows throughout a skillful handling



and economy of words which should make it extremely popular among student nurses, graduate nurses, and teachers at nurses' schools.

**DENTAL HISTOLOGY AND EMBRYOLOGY**, by *B. Orban, M. D., Professor of Dental Histology and Pathology, Chicago College of Dental Surgery, a Dental Department of Loyola University.* Second edition. P. Blakiston's Son & Co., Philadelphia, 1929.

This edition of Doctor Orban's book contains 218 pages of text profusely illustrated by clear-cut photomicrographs and explanatory diagrams. Several changes have been made in regard to the chapters on dentin and to the development of the bifurcation of multirooted teeth which are in keeping with advanced investigations.

An outstanding feature of this treatise is the confining of the text to clear and concise explanation and description of the photomicrographs and diagrams. The book is exceptionally well published and affords an admirable medium to the student and practitioner for reviewing quickly the subjects treated.

**THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY**, by *W. A. Newman Dorland, A. M., M. D., F. A. C. S., Lieutenant Colonel, M. R. C., United States Army, Member of the Committee on Nomenclature and Classification of Diseases of the American Medical Association.* With the collaboration of *E. C. L. Miller, M. D., Professor of Bacteriology and Biochemistry, Medical College of Virginia.* Fifteenth edition. W. B. Saunders Co., Philadelphia, 1929.

Although the revisions of this well-known dictionary have been many in its long career since its first edition in 1900, this latest revision has been the most thorough one. A corps of associates have searched the literature of the last two years with the result that a few thousand words appear here now in these 1,400 pages for the first time in any dictionary.

The official nomenclatures of the various national societies and councils have been followed.

The illustrations are ample and helpful. Much of the matter is arranged in tabular form, many new and valuable tables having been added.

**MEDICAL CLINICS OF NORTH AMERICA**, JULY, 1929. W. B. Saunders Company, Philadelphia, 1929.

The July number of the *Medical Clinics* is a Boston number, and with the exception of 4 of the 27 contributors, all are on the staff of the Harvard Medical School. Doctor Minot, professor of medicine at Harvard, contributes an article on an atypical case simulating leukemia with anemia and thrombopenic purpura. From the New England Deaconess Hospital, an article is presented on diabetic coma which is very instructive. Particular stress is placed upon the "ap-

palling needlessness of diabetic coma." Great importance is placed on the necessity for vigorous and constant care, both nursing and professional, on the admission of the case. It is an excellent article. Dr. J. L. Morse presents a very complete article on abnormal respiration in children. Dr. H. A. Nissen has an article on atonic intestinal stasis and its possible relationship to chronic disease. This article again brings to the fore the intestinal tract as an etiologic focus for our chronic disabilities.

THE SURGICAL CLINICS OF NORTH AMERICA, AUGUST, 1929. Volume 9, No. 4.  
W. B. Saunders Co., Philadelphia, 1929.

This number, known as the Mayo clinic number, contains 25 articles by members of the Mayo clinic staff. Many of them report cases of rare conditions.

The leading article, by E. Starr Judd and Herman J. Moersch, discusses the diagnosis and treatment of pharyngo-esophageal diverticulum and reports a case. Since 1907, 185 patients with this condition were admitted to the clinic. Nearly all were operated on. A small stomach tube is introduced before operation and left in place for feeding purposes until after the wound has healed.

W. E. Sistrunk discusses the advantage of a combined oblique and transverse skin incision in operations for inguinal hernia.

L. A. Buie and Theodore Swan have contributed a long and instructive article on benign tumors of the colon.

Of particular interest is an article by J. S. Lundy on the present status of various anæsthetics at the Mayo clinic. During 1928, 40 per cent of the operations were done with local anæsthesia, 30 per cent with gases, 16 per cent with ether, and 1 per cent with spinal anæsthesia. Chloroform has not been used since 1927.

THE MEDICAL CLINICS OF NORTH AMERICA, SEPTEMBER, 1929. Volume 13, No. 2.  
W. B. Saunders & Co., Philadelphia.

This number contains contributions from the leading clinics of Chicago.

The first paper is by Dr. Arthur R. Elliott, who discusses the serious effects of epistaxis in cardiovascular conditions, and reports two fatal cases from his clinic at St. Lukes Hospital. One case was that of a man aged 22, who had had a long-standing chronic nephritis with arteriosclerosis. The other was in a man aged 50, with angina and coronary occlusion.

Dr. Lewis J. Pollock has written an instructive paper on the neurological aspects of optic neuritis. He points out the need for a clear definition of papilledema, papillitis, and optic neuritis, and the necessity for methods of ophthalmological differentiation of these

conditions in the diagnosis of brain tumors and other intracranial lesions.

Dr. Charles S. Williamson presents four cases of mediastinal conditions and gives an interesting discussion of the differential diagnosis.

**INTERNATIONAL CLINICS, VOLUME III, 39TH SERIES, SEPTEMBER, 1929. J. B. Lippincott Co., Philadelphia, 1929.**

This quarterly number of the International Clinics contains matter of particular interest to medical officers. Henry W. Cattell, editor of the International Clinics, recently returned from the Fifth International Congress of Military Medicine in London, gives an account of the congress and a digest of the papers there presented.

The leading contribution to this number, and one which impresses the reader as having unusual value, is Katherine H. Coward's paper on Recent Research on the Vitamines and its Clinical Applications.



# THE DIVISION OF PREVENTIVE MEDICINE

Capt. M. A. STUART, Medical Corps, United States Navy, in charge

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## NOTES ON PREVENTIVE MEDICINE FOR MEDICAL OFFICERS, UNITED STATES NAVY

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### THE VENTILATION PROBLEM OF THE HALLS OF THE SENATE AND HOUSE OF REPRESENTATIVES

By G. W. CALVER, Commander, Medical Corps, United States Navy

The Senate, realizing that available space in the United States Capitol Building in Washington, D. C., was rapidly becoming inadequate, due to the increasing requirements of the Republic, passed a resolution, on May 28, 1850, directing the Committee on Public Buildings to hold a competition to obtain plans which would be suitable for the construction of additions to the Capitol and offered a prize of \$500 for the accepted design. Of the plans eventually submitted, four sets devised by as many different architects were accepted and the prize divided equally among them.

The better features of each of these four sets of plans were combined in a final set prepared under the direction of Mr. Robert Mills. These were submitted to the committee and accepted. President Millard Fillmore evidently considered the action of the Senate in authorizing a competition not within the law, as he stated in his annual message of December, 1851, that an act of Congress approved September 30, 1850, contained a provision for "the extension of the Capitol according to such a plan as might be approved by the President and appropriated \$100,000 to be expended under his direction by such architect as he should appoint to execute the same." Acting under this authority, President Fillmore appointed Thomas U. Walters architect of the United States Capitol extension, and on the 10th of June, 1851, approved a general outline of the plan submitted by Walters. July 4, 1851, the cornerstone of the Capitol extension for the House was laid with elaborate civic and Masonic ceremonies. Neither the Senate nor the House seems to have been consulted as to the character of the arrangements in the building that was being erected for their comfort and convenience, as the Senate on March 16, 1852, directed the Committee on Public Buildings to make a

thorough examination of the work which had been completed on the Capitol extension and to obtain the aid of the United States topographical engineers and others whose assistance was considered valuable.

Progress in the work had been unsatisfactory and questions arose as to the quality of the mortar mixtures used in the brick and stone work, so the President directed the Secretary of War to designate an officer to act as superintendent of construction. Capt. M. C. Meigs, United States Army, was designated, and supervised the construction work during his tenure of office. This included the construction of the north and south wings of the Capitol, known at present as the Senate and the House. It may be mentioned here that actual construction was started in 1851. The House Chamber was first used December 13, 1857, for divine services, and that body took formal possession on December 16, 1857. The Senate wing was delayed by the slow delivery of iron work and was officially occupied January 4, 1859.

In the plans on which work was started the meeting halls or chambers were placed in the western face of the extensions, which in turn were sufficiently remote to avoid interfering materially with the natural light and ventilation of the rooms in the main or old building.

Captain Meigs in 1853 modified the plans by which work was being done, making changes which placed the halls in the center of the extensions. At this time he accepted the designs of Mr. Charles F. Anderson for a down-draft system of ventilation for the chambers of the Senate and of the House of Representatives. In 1855 he reversed his opinion and employed a Mr. Robert Briggs to redesign the ventilation system. In making these changes he inadvertently devised a plan of ventilation which has been a source of trouble and annoyance to the members of both legislative bodies and to many of the Nation's most prominent ventilation experts for many years.

Mr. Anderson had designed and included in his plans a system of ventilation which contemplated the delivery of fresh air from overhead inlets with exhaust outlets located in the floor, but Captain Meigs, being unwilling to accept Mr. Anderson's plans in toto, ignored this provision and employed another individual to reconstruct detailed plans of a system of ventilation. This gentleman changed the down-draft system of Mr. Anderson's into the up-draft or so-called American system used at that time in many buildings in the United States, although it was contrary to experience abroad, notably in the House of Commons in London, the hall of the Institute of Paris, and numerous other buildings, where the down-draft system was employed with great success. Captain Meigs, being ill at the time, did not supervise this design, but upon his recovery and

return to duty he made some minor alterations and accepted these plans as a basis for the installation, notwithstanding the fact that a letter approving the original plans had previously been written on May 19, 1853.

A brief description of the arrangement of the buildings is necessary to understand the salient points regarding the problem of ventilation. The Hall or Chamber of the House, which runs east and west, is a very large oblong room over 139 feet in length and 90 feet in width, with a ceiling height of 36 feet. Large corridors surround the Chamber on both the main and gallery floors on all sides except the south. The committee rooms are located between the corridors and outer walls on the east and west, while the Speaker's lobby is directly south of the Chamber on the main floor, and the press rooms occupy a similar position on the gallery floor. The passageway from the central building joins the House on the north and opens directly into the north corridor of the main floor. A similar space on the gallery floor is occupied by offices. The only outside windows opening into the corridors are in the north walls adjacent to the passageway and in the south where the corridors touch the outside walls. Consequently the corridors receive natural light and ventilation only from the north and south windows, and from the committee rooms should the doors happen to be open. Artificial light is needed practically at all times in these corridors, and the air frequently becomes close and stuffy due to the lack of proper attention to the windows. Ventilation in the corridors is entirely dependable upon such circulation of the air as may be obtained from natural sources.

The Senate Chamber is slightly smaller than the House, being 113 feet long and 80 feet wide, while the height is the same. On this side the corridors are larger and have much better natural light and circulation of air. Because of fewer Members, the question of crowding is of materially less importance in the Senate.

There is another factor in the problem of ventilation. When the extensions to the Capitol were planned and constructed the requirements of the human body in regard to oxygen, circulation of the air, heat, and light were comparatively little understood. Hygienists now tell us that 2,000 cubic feet of air per hour, or, roughly, 30 cubic feet per minute, are necessary for good ventilation. These figures do not take into consideration temperature, humidity, and air motion, which factors may materially increase the amount of air required or necessitate accessory appliances not only for increasing the circulation but also for cooling the air in order to secure comfort. As Park points out, "Hygienists must insist on standards of air conditions actually maintained rather than on any arbitrary mechanical standards assumed to be capable of maintaining them. Any system which

does not guard against overheating is inadequate, however large a volume of air may be forced into the room."

Ventilation as originally planned included both natural and the combined mechanical supply, or plenum system of heating and ventilation, assisted by the use of exhaust fans. Natural ventilation by means of windows furnished fresh air to the committee rooms and the corridors, while the plenum and exhaust systems were connected with the chambers. In the latter, the air was first heated by passing over steam coils and then forced through openings placed in the floor and at the base of the walls. A revolving or wheel type of fan constructed of wood and iron with a maximum designed delivery capacity of 51,000 cubic feet of air per minute driven by a directly connected steam engine furnished the power. Brick ducts were used. It was soon discovered that they became clogged rapidly with *débris* of various sorts. It was also found that the floor inlets or registers had been placed where dust could readily lodge, temporarily, to be ejected into the faces of the Members when air was supplied by the fan working at full capacity. The registers served in the dual capacity of ventilators and cuspidors. Some of the registers had a coating of 1½ inches of dried saliva combined with dried tobacco juice when they were removed.

The ceiling of the Chamber is of glass. Large areas of this material are set in the interstices between longitudinal and transverse beams. Above the ceiling is an attic, the vertical dimension of which varies from 10 to 25 feet. Originally the system of ventilation provided for the ascent of the heated air from the Chamber through openings in the glass ceiling into the attic from which it was to be exhausted into the outside air by a fan with a capacity of 35,000 cubic feet per minute. The roof was originally of tightly fitting sheets of corrugated copper firmly secured to an iron frame. The metal, expanded by heat and contracted by cold, caused many of the joints to become loose so that in a comparatively short period of time the exhaust fan instead of removing vitiated air from the Chamber and thus assisting in the process of ventilation was drawing air through the loose joints of the roof and immediately returning it to the outside. Moreover, in winter the cold air drawn in through these cracks chilled the glass in the ceiling, thereby causing down drafts of cold air with the attendant discomfort to the Members of the House. In reviewing errors made in the construction of the system of ventilation, Mr. Anderson submitted the following comments, in part, which are extremely interesting:

The erroneous plan adopted by Captain Meigs, which has been operating since the occupation of the Halls, and now exists in both Houses, receives the exterior air under the ground floor from off the surface of the overheated and dusty terraces, furnishing much of the bad air from beneath, carried to its surface



by evaporation and side currents of air from the ground, and this air is also tainted with much of the odors caused by the machinery near which it passes.

The air injured by these causes is drawn to the openings in the cellar or subbasement walls by the action of the fan wheel, which forces it up under the floors of the two Houses, where it finds vent through the gratings under the Member's desk, the risers in the floors, and openings round the Halls, and in the galleries. By the action of these currents the vapors introduced from below rise from the floors of the Halls and keep in constant motion the vitiated air generated by the breath of the persons occupying the floors and the galleries, of which carbonic-acid gas, being heavier than the purer part of the atmosphere of the Chambers, is constantly tending to and settling upon the floors, and would remain upon the floors like a malaria or noxious miasm were it not kept in motion near the floor by the currents of dirty air coming up through the gratings and registers; there is added to this bad air all the dust produced by the walking or movements upon the floor, independent of that brought from below. This atmosphere of the Halls, as at present arranged, can not be otherwise than unwholesome, and were it not for the frequent opening of the doors leading into the Halls would prove much more oppressive and intolerable than it is. To persons of weak lungs, however, the deleterious effects of the present arrangement are more immediate and sooner felt than by persons blessed with more robust constitutions; but even these may be taken sick without any apparent cause unless it can be traced to the fact that the seeds of the sickness have been unconsciously imbibed while sitting quietly in their seats, and much more so while engaged in speaking or in the heat of debate, when the lungs must of necessity become inflated and irritated by this pernicious atmosphere.

No information can be found as to whether the change in the system of ventilation was made on account of professional jealousy or for other reasons. However, as an interesting side light, increasing friction occurred between Captain Meigs and Mr. Thomas U. Walters, the Architect of the Capitol, until finally the former was relieved in 1859 by Captain Freeman, United States Army. Whether this controversy had any effect regarding the change can not be stated, but one can not but believe that Mr. Walters at first, at least, sympathized with and backed his fellow craftsman. It is also of interest to note that Mr. Walters had himself prepared a system of ventilation of the Halls and that they included a "down-draft" system, but these plans were entirely disregarded, as were Mr. Anderson's.

#### INVESTIGATIONS AND ALTERATIONS

Starting on February 23, 1865, with the investigation by a committee of which Mr. Buckalew was chairman, hardly a session passed without some disparaging remarks being made which were directed at the then existing ventilation. Mr. Anderson submitted plans for alterations which were approved by this committee, but these alterations were never effected. Considerable attention was given to the chemical composition, humidity, and air currents by investigators

from the Smithsonian Institute. Great stress was placed upon the "burnt condition" of the air due to the heating and resultant lowering of the humidity. Several minor changes were made, such as shunting part of the air around the heating coils to avoid "burning." Air was passed over small pools of water placed in the ducts, but, as might be expected, even hot dry air over the surface of still, standing water will take up so little moisture that the question of satisfactory humidification remained unsolved.

June 20, 1868, Mr. Covode introduced a resolution authorizing the Committee on Public Buildings and Grounds "to examine and report to the House by what means a sufficient supply of pure air may be obtained for said Hall and that the committee be empowered to use the present means of ventilation to the best advantage at present, and that they report by bill or otherwise." This committee secured the services of Gen. Hermann Haupt, chief engineer of the Pennsylvania Railroad, and Mr. Lewis W. Leeds, a specialist in heating and ventilation, to investigate the atmospheric conditions in the House. They eventually finished by making the cryptic recommendation "that some one of ability and experience be employed to further examine and report upon the subject." The chief accomplishment, resulting from their examinations, was the installation of open fireplaces to assist in the ventilation of the cloak rooms and halls, but even this was not done until nearly four years later.

In November, 1868, Mr. A. J. Marshall made a very exhaustive investigation and reported in favor of a "down-draft" system. Mr. William Loughbridge on June 23, 1870, prepared just the opposite plan, which included the installation of a plenum chamber under the Speaker's desk. On March 3, 1871, Mr. Jenckes, chairman of a select committee, made a report stating there had been several investigations and many reports made, but that "the investigations and the elaborate reports which followed them have led to nothing substantial in the way of improving the condition of the two Halls." The Members of the two Houses did not agree with the reports and were not willing to profit by the advice which they received. Since all sorts of conflicting opinions were available, any change seemed too much of a gamble.

The committee, of which Mr. Jenckes was chairman, thought, however, that the weakest part in the system was the roof, and their report resulted in a fireproof ceiling being placed a few inches below the roof. This immediately removed the down drafts caused by the cold air coming through the cracks in the metal roof and enabled the exhaust fans to operate successfully for the first time. Considerable improvement was noted, but still when the 1,400 gas jets were lit in the space above the ceiling, great heat was generated and much difficulty was encountered from that source. No method had as yet been

employed to moisten the heated air, and the hot-air currents from the floor registers still ascended directly to the glass ceiling and were exhausted from the attic without removing all of the foul air and body odors, an appreciable amount of which still was present in the room. Thereupon fireplaces were built and additional flues constructed. These changes were followed by a decided improvement.

From the Speaker's platform and radiating to the sides and rear of the room, similar to an amphitheater, the floor consists of a series of semicircular steps or platforms upon which the desks assigned to the various Members are fixed. The ventilation inlet registers were removed from the floors and placed in a vertical position in these steps, thus diminishing their availability as a "spit kit." A great improvement in ventilation was experienced following these changes.

In 1876 the air supply to the gallery was improved by the installation of two large ducts; also in this year a commission consisting of Joseph Henry, Thomas Lincoln Casey, Edward Clark, F. Schurman, and John S. Billings was appointed to consider the problem of ventilation with a view of improving existing conditions. They recommended the installation of metal air ducts, some method of moistening and cooling the air, a tower intake 200 feet away from the Capitol Building, electric signals from the halls to the engine room, and the control of heating and ventilation by one man. Mr. Robert Briggs was again employed, and during the years 1877-1879 he supervised and completed the above recommended alterations. Minor changes, such as the installation of larger registers and air ducts for those already in use, were made nearly every year until 1896.

Mr. S. H. Woodbridge was placed in charge of the heating and ventilation of the Capitol building at this time and remained actively in contact with this work until his death, which occurred in 1925. During the years 1896 and 1897 the entire woodwork of the floors and gallery of the Senate were removed under the direction of Mr. Woodbridge and replaced with an iron framework and airtight wooden floors. Plenum chambers were constructed under the floors of the Senate and the gallery with independent arrangements for heating and supplying the air to each. The air delivered to the gallery was heated slightly more than that for the floor in order to avoid a downward draft. Supply diffuser openings, with an area of about 120 square inches for each, were placed in the broad slabs of wood which formed the supports of the desks on the floor and the chairs in the gallery, and also placed vertically in the sides of the amphitheater steps of the main floor. Brine coils were installed to cool the air in summer; water sprays were introduced for the purpose of washing and moistening the air, and the steam coils were renewed. New exhaust ducts leading to a fan capable of removing from 800 to 1,000 cubic feet of air per minute as a minimum were connected

with each cloak room. A separate system equipped with a new fan was constructed to heat and ventilate the corridors, and pneumatic steam valves, which could be set at the desired temperature, were installed to control, automatically, the amount of steam delivered to the heating coils. Mr. Woodbridge also recommended the use of metal ducts which were to connect all corridor flues with an exhaust chamber. An operating board with a series of valves, thermometers, and switches was built in the ventilating engineer's office so that one man might have complete control of the entire ventilation system of the Senate wing.

He next in 1898 and 1899 completed a similar overhaul and replacement in the House, together with repairs to the ceiling and roof. At the same time changes were made in the ventilation of the committee rooms of the south wing. In 1900 and 1901 increased ventilation was installed in both the House and Senate kitchens and restaurants to avoid having the odors from these places rising and being diffused throughout the building. A new fan was also installed in the Senate ceiling. In 1902 and 1903 additional exhaust fans were installed in the roofs of both the Senate and the House. No record of other major changes by him was found until 1924 and 1925, when an attempt was made to improve the ventilation of the Hall of the House in accordance with the recommendations submitted by the United States Public Health Service. The present installation is the result of an investigation made by a committee of which Prof. C. E. A. Winslow, professor of public health, Yale University, was chairman, and which consisted of 10 additional members selected for their knowledge of the subject. This committee met and considered the conditions then existing and made certain requirements that should be met in the manufacture and installation of apparatus required to properly ventilate and condition the air in these two chambers. A letter was prepared setting forth the conditions to be met, and submitted to a selected number of bidders believed to be capable of manufacturing and installing suitable apparatus. The bid of the present contractor was accepted, it being considered that his proposed equipment and plans would come nearer to performing the desired service required by the investigating committee than those of the other two bidders.

#### NEW EQUIPMENT

A description of the equipment for the House wing will suffice for both, since that for the Senate side is identical in principle. The equipment is designed to cleanse the air thoroughly; that is, to filter and wash it, thus eliminating all dust and solid matter from the air to be delivered to the spaces which are to be ventilated.

During the summer season the air is cooled and dehumidified. During the winter season the same equipment will operate to cleanse the air, to warm it, and to establish a proper and healthful condition of humidity within the rooms which are supplied. The final function of the completed aeration equipment is to provide a uniform distribution of treated air within the rooms without the creation of objectionable drafts.

The equipment which conditions the air and distributes it to the various parts of the building ventilated by the system is divided into several separate but interrelated units. These supply air to the floor of the House, to the gallery, the cloak rooms, and to the press rooms. In all there are seven air-propelling units, each performing a separate function. In the description which ensues these units will be referred to by number in the order of their presentation. The following list gives the location and purpose of the various parts of the equipment:

Apparatus No.	Location	Function
1.....	Apparatus room, terrace court south.	Receives air from intake, filters, washes, and heats it for floor of House. Capacity, 36,000 cubic feet per minute.
2.....	Apparatus room.....	Receives air from in-take tunnel, filters, washes, and heats it for gallery of House. Capacity, 36,000 cubic feet per minute.
3.....	do.....	Receives washed air from No. 1, and heats and delivers air to 2 cloakrooms of House. Capacity, 6,200 cubic feet per minute.
4.....	Attic of House.....	Exhaust fan for air from gallery plenum and cloakrooms during winter season. Capacity, 18,000 cubic feet per minute.
5.....	do.....	Draws air in from outside above roof, heats it, and supplies warmed air to attic spaces in winter. Recirculates air when desirable. During summer season draws air from gallery plenum and cloakrooms and discharges same over House ceiling. Capacity, 18,000 cubic feet per minute.
6.....	Apparatus room.....	Draws air in from courtyard and acts in place of water tower to cool the condenser cooling water by spraying and aeration; air discharged through duct in roof. Capacity, 49,000 cubic feet per minute.
7.....	Attic of House.....	Draws air in from above roof, filters, washes, and heats it for press rooms at rear of press gallery. Capacity, 7,000 cubic feet per minute.
Refrigeration unit.....	Apparatus room.....	Cools air wash water used in apparatus Nos. 1, 2, and 7, to wash air and control humidity. Capacity, 206 tons in 24 hours.
Pump No. 1.....	do.....	Pumps air wash water for apparatus Nos. 1 and 2. Capacity, 660 gallons per minute.
Pump No. 2.....	do.....	Pumps air wash water for apparatus No. 7, in attic space.
Pump No. 3.....	do.....	Pumps condenser cooling water through No. 6. Capacity, 720 gallons per minute.
Air compressor No. 1.....	do.....	Compresses air for thermostat diaphragm valves, and air motors; pressure, 30 pounds.
Air compressor No. 2.....	do.....	Same as above but set to compress to 25 pounds, and as spare when No. 1 is out of commission. Automatically started on fall of pressure below 25 pounds.

The air to be treated is brought from the intake towers first into contact with an air filter which consists of metal surfaces coated with a viscous oil upon which the air must impinge and there be freed of a considerable portion of solid particles, dust, and dirt which it is likely to carry. Next the air passes through a chamber into which a large quantity of water is atomized into a dense mist or spray as it is forced through numerous small nozzles under pressure. Here the

final washing or cleansing is performed, and soluble gases and odors are largely eliminated. Here too, an important step is taken in establishing the desired moisture content of the air. Since the air leaves this chamber saturated at approximately the temperature of the water spray, the control of the temperature of the water spray provides the means for establishing the moisture content or dew-point temperature of the air leaving the chamber.

It is interesting here to note that cooling and dehumidification is performed during the summer season by a refrigeration unit which cools, to a predetermined temperature, the water supplied to this spray chamber. When air, having moisture content or humidity higher than that desired, comes into contact with water at these reduced temperatures, condensation of the excess moisture occurs in just the same manner as moisture condenses on the sides of a pitcher of ice water. Likewise, the water spray serves during the winter to make up the deficiency in moisture which is due to the increased dry bulb temperature of the treated air.

Of course it is not desirable to deliver air to the room in a saturated condition and at a comparatively low temperature. Subsequent warming is necessary. This is done by mixing the air with some warmer refiltered air, which has been drawn from the building, an economy which is practiced at all possible times, or the air is passed over automatically controlled steam heaters.

The movement of the air through the air filters, the spray chamber, and the final mixing chamber is performed by the suction side of a large centrifugal fan. Entering the fan the air is then discharged into a system of metal ducts, through which it is forced to the spaces to be ventilated. The air enters the room through carefully designed and regulated diffuser outlets located at the ceiling, from whence it mixes with the air in the room and forms what is essentially a blanket of air diffusing down over the occupants, fresh air reaching the breathing zone first. There are always whirls and eddies in an air stream, irrespective of velocity, so that there is considerable mixing with the incoming air. The general rate of downward flow is designed to carry away as much "old air" as possible. The air is ultimately withdrawn from the room at the floor line. A portion of it is returned to the apparatus for refiltration and admixture with freshly treated outdoor air, while a portion of the air corresponding roughly to the quantity of outdoor air taken in is constantly discharged out of doors. The system is designed to give a positive pressure equal to one-half inch of water in the spaces supplied.

A complete system of automatic temperature and humidity control operates in conjunction with all parts of the air equipment. (Fig. 7.) These instruments are set at a desired temperature and function through the operation of dampers within the air ducts.

and at the air intakes as well as through the regulation of steam valves and water temperatures, all coordinating to produce as the ultimate result a uniform temperature within the spaces which are under control.

An automatic electric recording instrument is located in the principal apparatus room in the basement. This instrument indicates to the operator in charge the condition existing in all parts of the equipment and within all of the spaces to which air is being supplied. Specifically, the instrument provides a continuous and permanent record, as follows:

1. The temperature of the wash water entering the spray chamber.
2. The temperature of the wash water returned to the refrigerating machine.
3. The temperature of the water entering the condenser of the refrigerating machine.
4. The temperature of the water leaving the condenser of the refrigerating machine.
5. The temperature of the outdoor air entering the building.
6. The temperature of the air at the discharge side of the fan leading to the floor zone.
7. The wet bulb temperature of the air returning from the floor zone.
8. The temperature of the air at the discharge of the fan leading to the gallery zone.
9. The temperature of the air returning from the gallery zone.
10. The temperature of the air in the Republican cloakroom.
11. The temperature of the air in the Democratic cloakroom.
12. The temperature of the air on the Republican side of the House floor.
13. The temperature of the air on the Democratic side of the House floor.
14. The temperature of the air on the Republican side of the gallery.
15. The temperature of the air on the Democratic side of the gallery.
16. The temperature of the air in the attic.

The major portion of the air-conditioning equipment is located in a room, approximately 100 by 30, in the basement of the House wing, which faces on a court at the ground level. Apparatus No. 1, situated in this room, is devoted entirely to supplying air to the floor of the House Chamber. A description of the interesting method used to separate the air of the floor and balcony is presented in a later paragraph. This unit delivers 36,000 cubic feet of air per minute to the zone occupied by the Members of the House. All of the air passing through the air conditioning chamber is either washed or filtered or both. Three hundred and fifty gallons of water per minute are delivered into the spray chamber for washing, cooling, and establishing the moisture content of the air in the process of conditioning. Apparatus No. 2, located in this room, supplies 36,000 cubic feet of air space per minute to the zone occupied by the spectators and press gallery of the House. Into the spray chamber of this unit 310 gallons of water per minute are atomized for the purpose of washing and humidifying the air. Apparatus No. 3 is

located in this room. It consists of a fan and two sets of automatically controlled heaters situated in separate ducts leading to the two cloak rooms of the House and draws its filtered and washed air

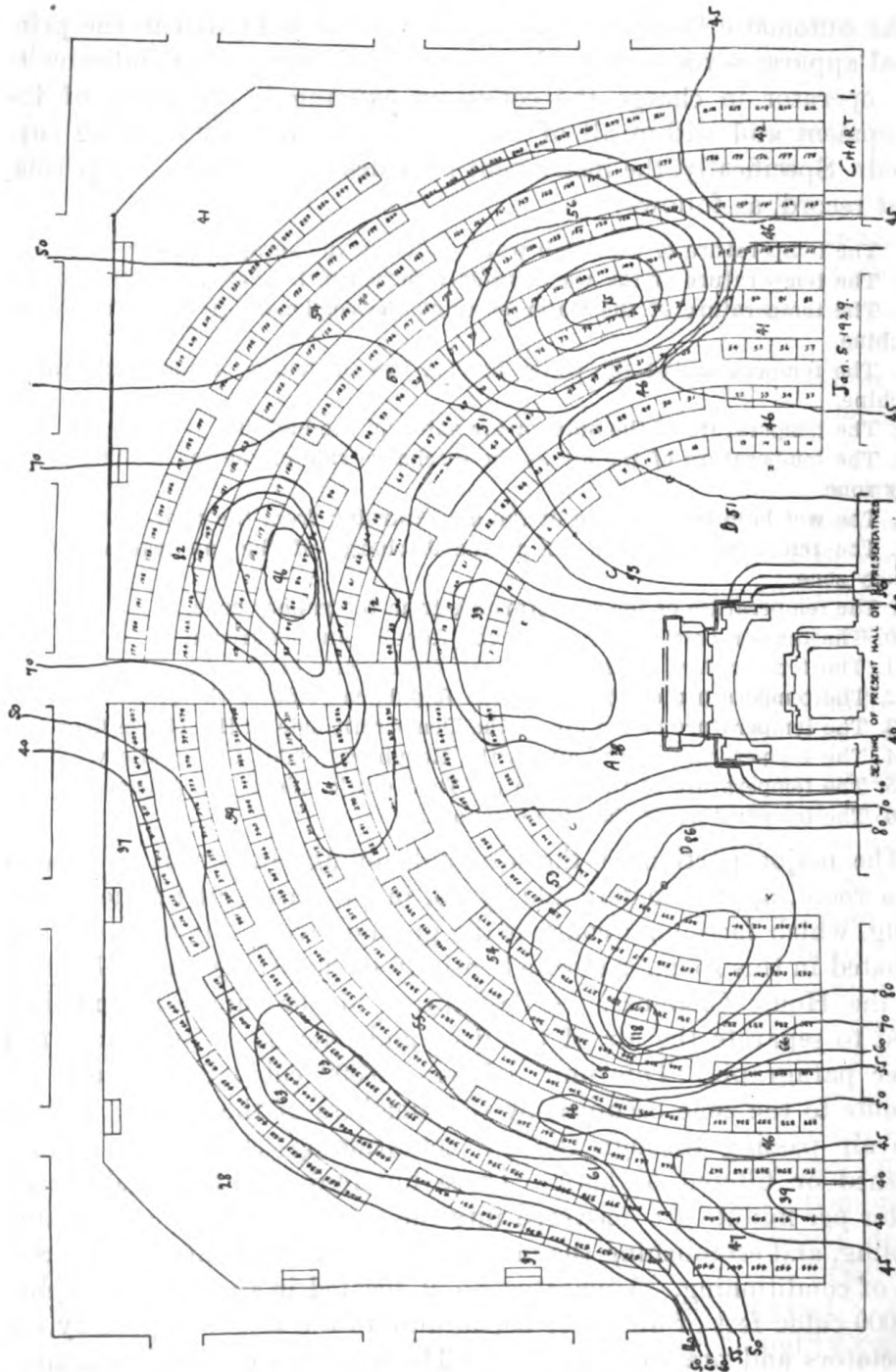


FIGURE 1.—Isometric chart of velocities on floor of House of Representatives before adjusting dampers and exhausts. Prepared by Public Health Service

from apparatus No. 1. The refrigeration unit, which is provided to operate in conjunction with the air-conditioning equipment for the purpose of supplying refrigerated water to the spray chamber during



the humid seasons, is also located in this basement room. It is well in discussing equipment in this section of the building, to mention some of the features of this particular piece of machinery. The refrigerant used is peculiar to this type of apparatus. It is a gaseous liquid chemical, dichloromethane. The process by which cooling of the water for the spray chambers is performed is as follows: Within

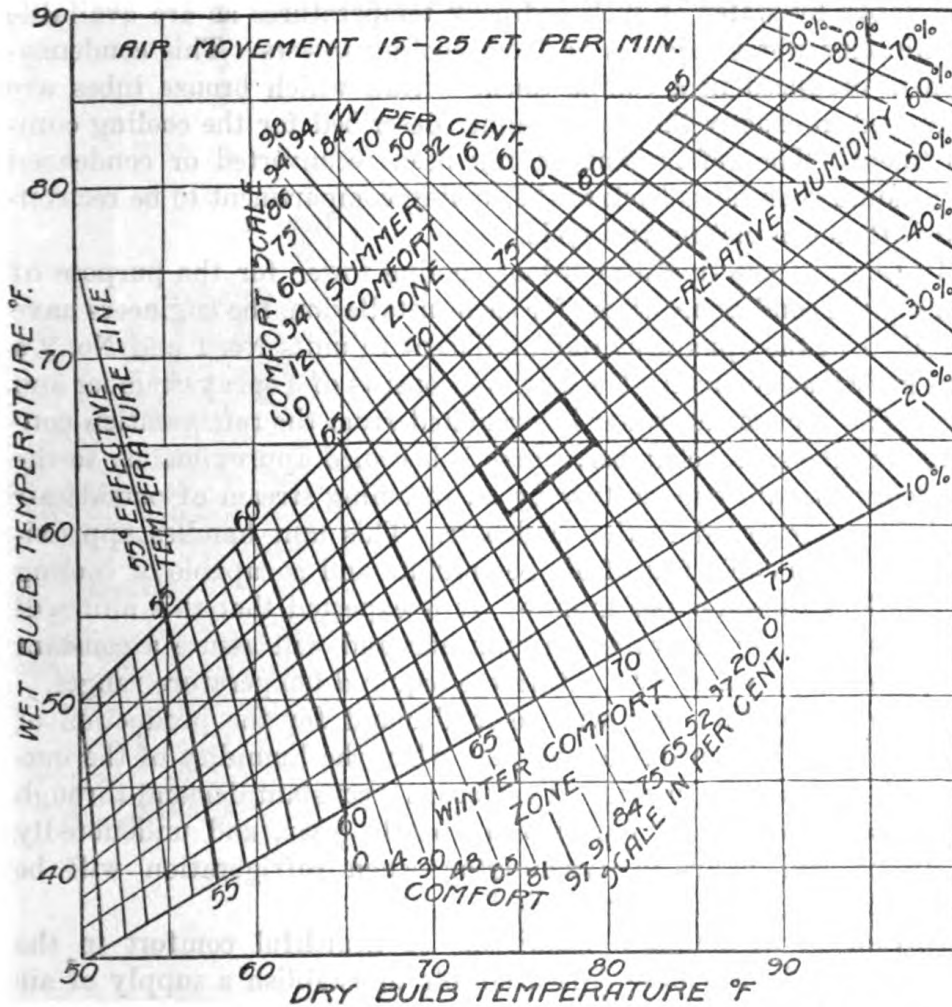


FIGURE 2.—Effective temperature chart with comfort zones superimposed (Yaglow, C. P., and Drinker, P. *Journal of Industrial Hygiene*, December, 1928) used in the determination of temperatures for each day's run. Heavy marked area was accepted summer ideal.

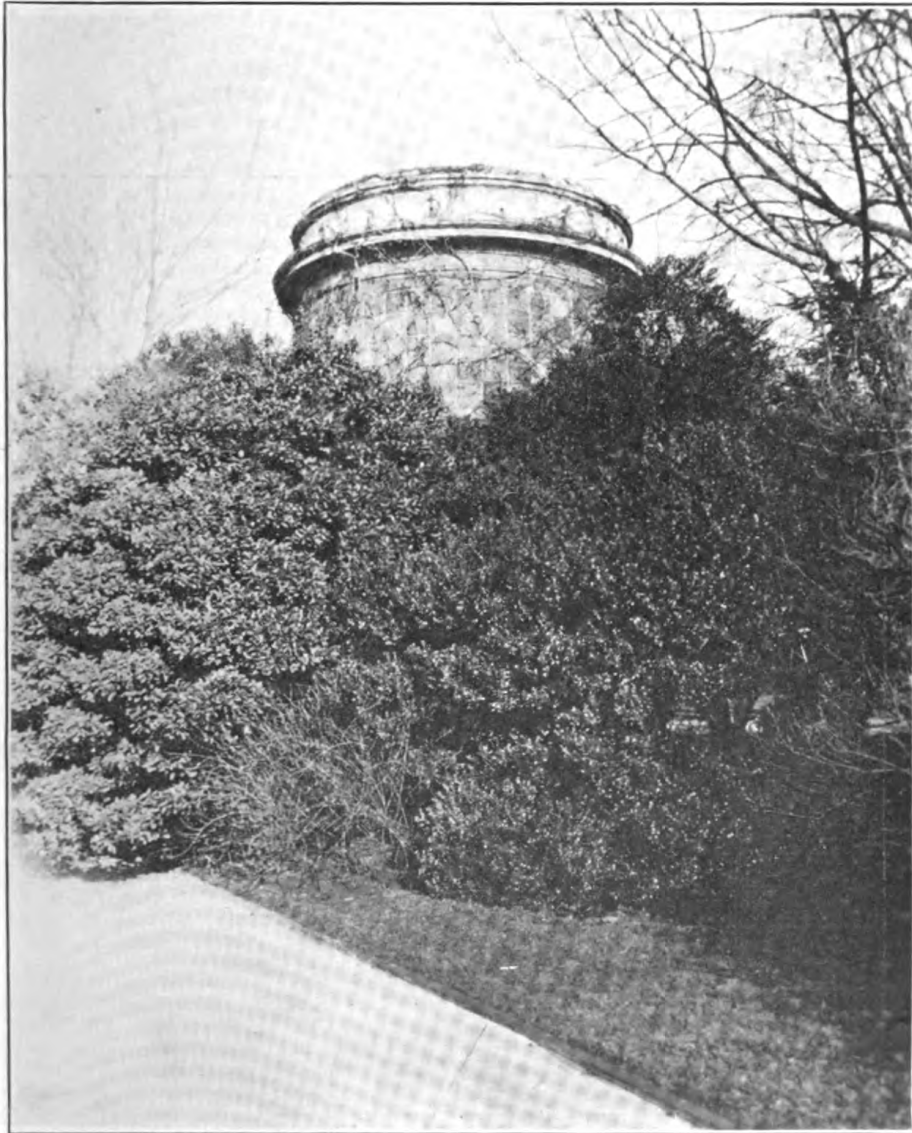
a vacuum-tight compartment known as the evaporator, the liquid refrigerant is allowed to flow over a large number of bronze tubes. Through these tubes the water to be cooled for the spray chambers is circulated. By means of a centrifugal compressor, which in many respects is similar to an ordinary centrifugal water pump, a vacuum of approximately 24 inches of mercury is maintained within this cooling compartment. At this reduced pressure the boiling point of

the liquid refrigerant is reduced to 35° F. Vigorous boiling occurs on the outside of the tubes and heat is absorbed from the water which is being circulated to and from the spray chambers. The vapor which results from this boiling is drawn into the centrifugal compressor. Through the several stages of the compressor the pressure of the vapor, though still at vacuum relative to the atmosphere, is raised to such a point that it is possible to cause condensation of the vapor by water at such ordinary temperatures as are available within city water supplies or from cooling towers. This condensation is produced in a compartment within which bronze tubes are arranged in exactly the same manner described for the cooling compartment. The refrigerant having been reconverted or condensed to a liquid then flows back to the cooling compartment to be recirculated, thus completing the cycle.

In place of erecting an outdoor cooling tower for the purpose of cooling the condensing water for each installation, the engineers have installed in the apparatus room adjacent to units No. 1 and No. 2 a unit known as apparatus No. 6, which consists of a spray chamber and fan. The condensing water is circulated from the refrigeration condenser to the spray chamber, where it is cooled approximately to the outdoor wet-bulb temperature by an incoming stream of outside air and thence returned to the condenser. This unit handles approximately 49,000 cubic feet of air per minute and is capable of cooling 720 gallons of water per minute. It is expected that this unit will effect an economy in water consumption and will assure a constant supply of clean water well within the required temperature ranges.

The refrigeration unit will be in demand for the production of cold water at all periods of the year when the humidity of the outdoor air exceeds 55 per cent. This means a constant demand through the greater portion of four months of the year, and undoubtedly occasions will occur in Washington when refrigeration will be required for an even longer period.

Obviously, to maintain conditions of healthful comfort in the entire Hall of the House it is desirable to establish a supply of air within the zone occupied by the Members which would be entirely unaffected by the variation of the spectators in the gallery. In other words, it seemed highly desirable to separate these two divisions of the Hall, and, in a sense, really to establish an invisible partition or curtain of air dividing the gallery from the House. It has been pointed out previously that the supply of fresh air reaches the Hall through carefully designed diffuser openings located in the ceiling. It has also been pointed out that completely separate and independent sets of apparatus supply the air to those openings immediately over the floor space occupied by the Members and to the openings over

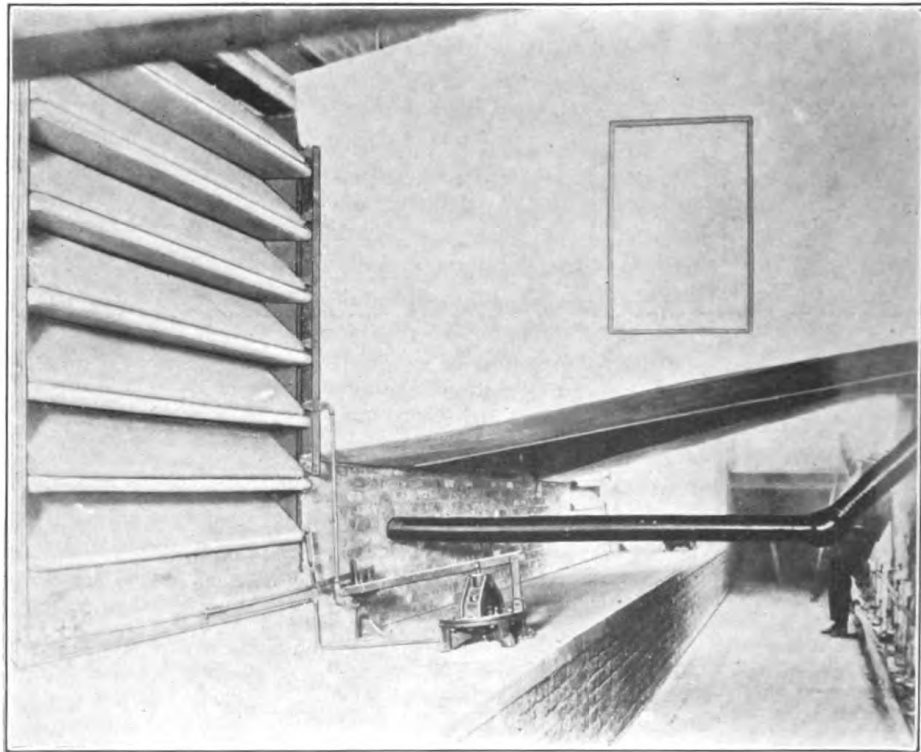


(Carrier Engineering Co.)

FIGURE 3.—AIR INTAKE TOWER. ONE OF THESE TOWERS IS LOCATED ABOUT 200 YARDS TO THE WEST OF EACH WING IN THE CAPITOL GROUNDS

190-1

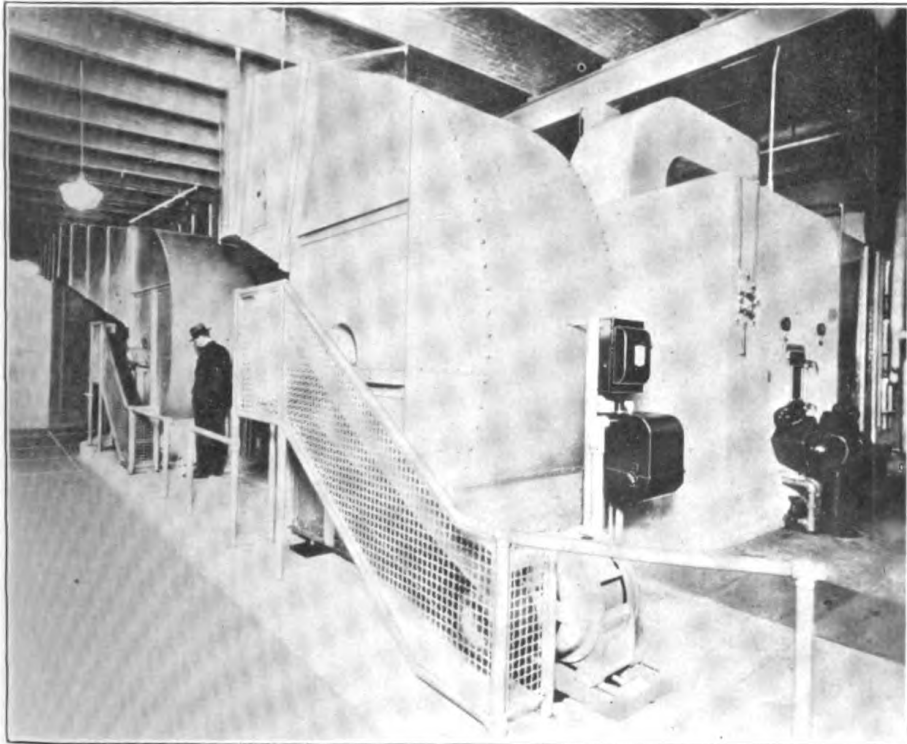




(Carrier Engineering Co.)

FIGURE 4.—HOUSE END OF TUNNEL CONNECTING WITH AIR INTAKE TOWER. TYPE OF DAMPERS USED TO CONTROL AIR FLOW SHOWN ON LEFT WITH AIR OPERATED MECHANISM CONTROLLING OPERATION

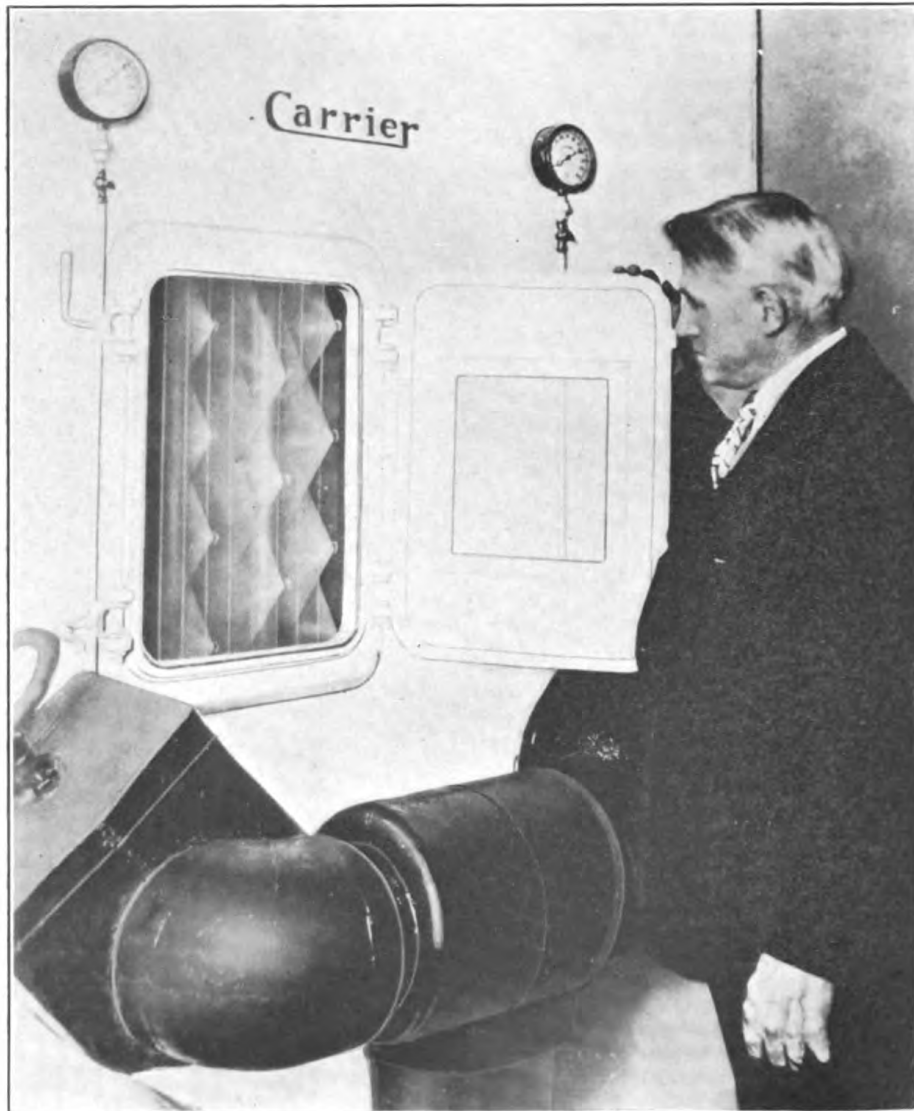
190—2



(Carrier Engineering Co.)

FIGURE 5.—APPARATUS ROOM OF HOUSE VENTILATION SYSTEM, UNITS 1 AND 2 IN FORE-  
GROUND

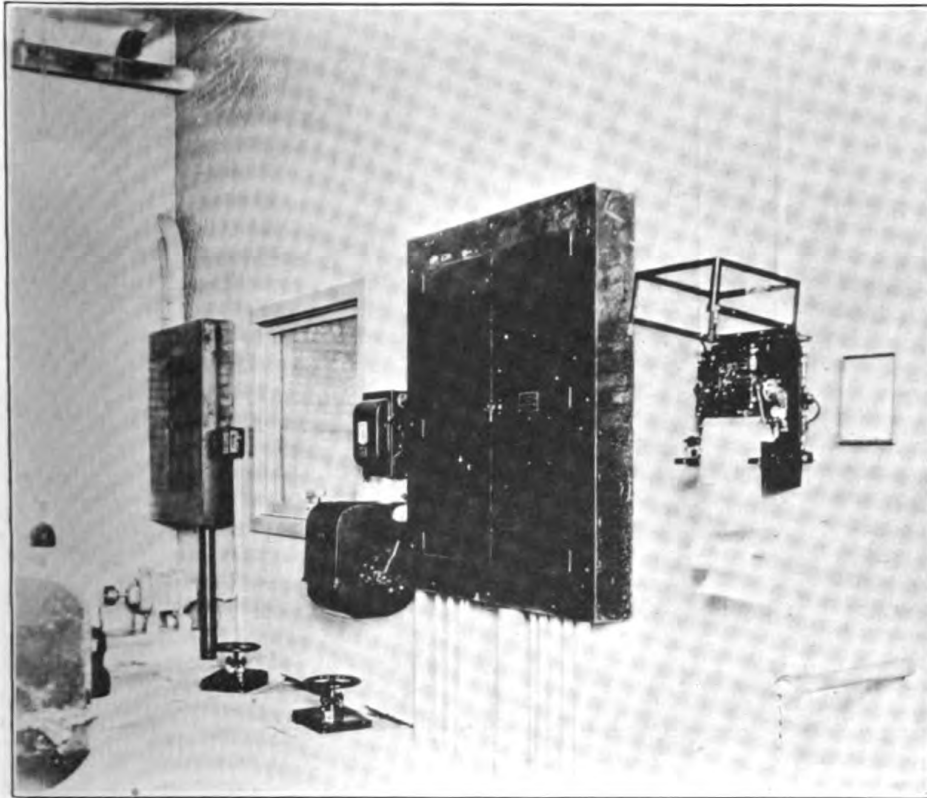
190—3



(Carrier Engineering Co.)

FIGURE 6.—AIR WASHING CHAMBER SHOWING SETS OF NOZZLES SPRAYING WATER. LARGE VALVES CONTROL PRESSURE IN SYSTEM

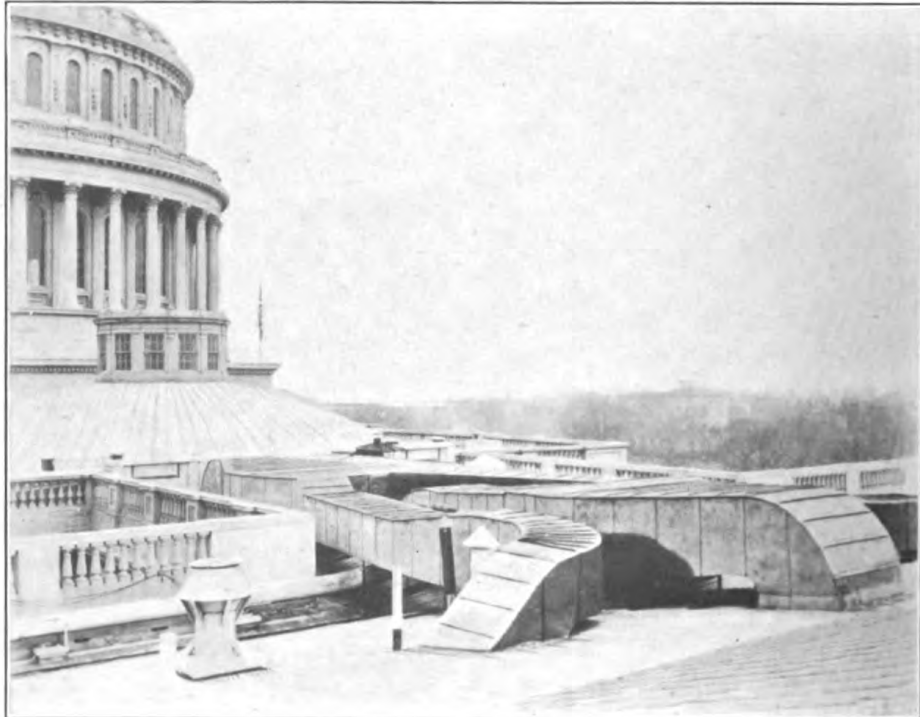
150—4



(Carrier Engineering Co.)

FIGURE 7.—CONTROL PANEL FOR SYSTEM. AUTOMATIC ELECTRIC TEMPERATURE RECORDING DEVICE ON WALL TO RIGHT

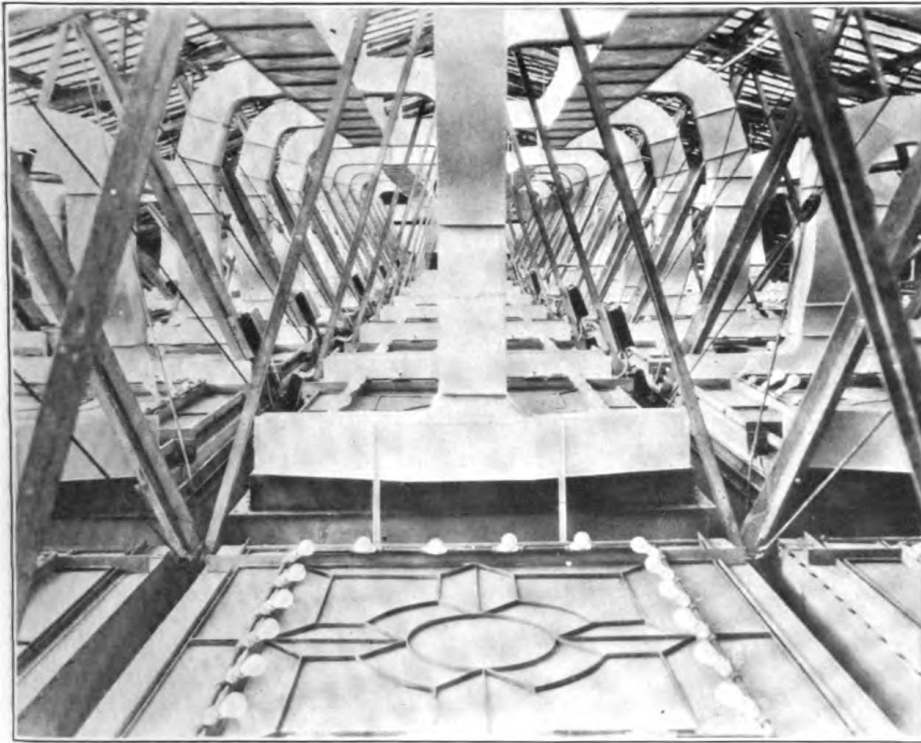
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(Carrier Engineering Co.)

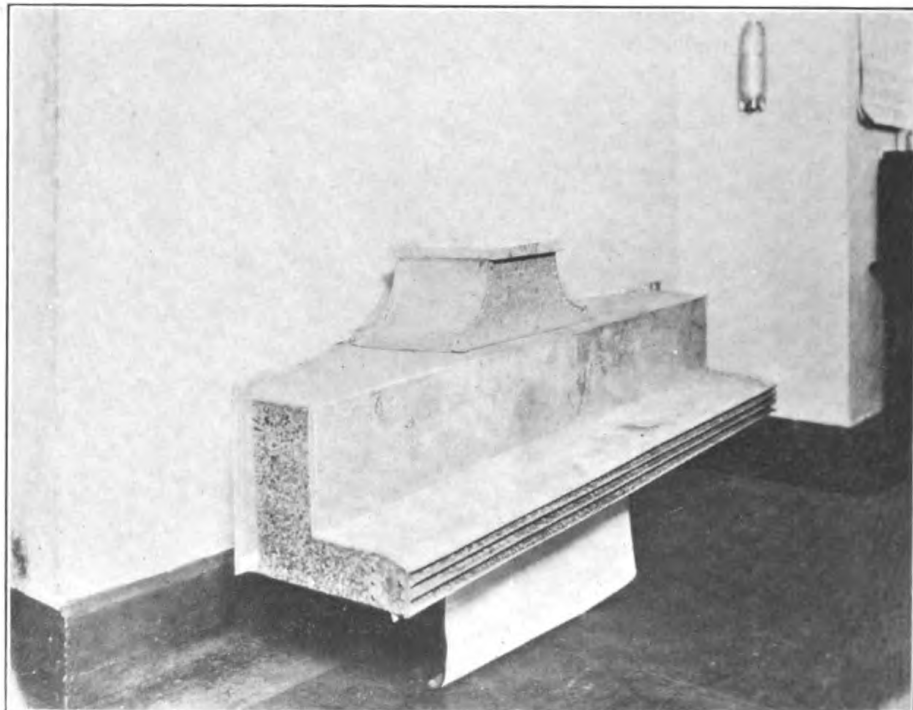
FIGURE 8.—COPPER SHEATHED AIR DUCTS ON ROOF OF HOUSE WING NECESSITATED BY STRUCTURAL DIFFICULTIES IN MAKING INSTALLATION. SOLID WALLS OF MASONRY NEARLY 6 FEET THRU HAD TO BE PIERCED FOR DUCTS IN NEW INSTALLATION  
190—6





(Carrier Engineering Co.)

FIGURE 9.—DISTRIBUTION DUCT SYSTEM IN ATTIC OF HOUSE. ELECTRIC LIGHT INSTALLATION USED TO ILLUMINATE THE HALL OF THE HOUSE THROUGH GLASS CEILING  
190-7



(Carrier Engineering Co.)

FIGURE 10.—AIR MANIFOLD AT END OF DUCT. THE SQUARES OF GLASS CEILING WERE RAISED AND THE SLOTTED EDGE OF MANIFOLD PLACED UNDER EACH END. THE SLOTTED PORTION IS ONLY PART OF ENTIRE VENTILATION SYSTEM VISIBLE FROM THE FLOOR OF THE HOUSE

190—8

the gallery space. These two divisions of the Hall also have independent lines which withdraw the air. Finally, in order to obviate any possibility of the air from the gallery spilling over onto the floor space, apparatus No. 4, which is located in the attic, serves the important function of withdrawing a slight excess amount of air from the gallery space. This tends to establish a reduced pressure zone in that particular region slightly lower than that immediately over the main floor and causes a flow of air back to the gallery rather than from the gallery over onto the floor. By this method there has actually been established what amounts to an invisible partition between the gallery and the floor which will leave the zone occupied by the Members entirely unaffected by variations in the number of visitors which from time to time may occupy the gallery. Apparatus No. 4 further serves to withdraw air from the two cloakrooms.

The metal ducts through which the air passes to the numerous diffuser outlets in the ceiling are suspended in the skylighted attic spaces immediately over the Hall. It was deemed important that something be done to avoid the change in the temperature of the air supply as it passes through these ducts, since it might be influenced by outdoor conditions in this attic space either in the winter or in the summer. To prevent this and to provide further assurance that the Hall would be unaffected by outdoor weather variations, treated air is supplied to this attic space. For this purpose apparatus No. 5 was located in the attic. During the summer this apparatus replaces No. 4 and serves, as has been described, to exhaust a certain quantity of cool air from the balcony and from the cloakrooms, distributing it into this attic space in its passage to out of doors. During the winter apparatus No. 5 serves to distribute a quantity of warm air within this same space. When the outdoor temperature is the same as that which it is desired to maintain in the House, apparatus No. 5 simply circulates outdoor air through the attic space, thus preventing the rise of temperature which would result from sun radiation. It is considered that this arrangement will effect an appreciable economy in the ventilation system and will further assure the effectiveness of the entire equipment.

Apparatus No. 7, located in the attic, supplies air to the four press-rooms arranged in line at the rear of the press gallery. The same accepted method of downward diffusion of the air is employed in these rooms. The equipment is the same in all essential details and operation as the larger equipment which supplies air to the House. During the warm, humid season refrigerated water is supplied to the spray chamber in this equipment from the one refrigeration machine which is located in the basement.

## CONCLUSION

After the installation was completed many peculiar difficulties were encountered. On the northeast corner of the floor a strong lateral draft was noted as well as lesser ones in other localities. A survey by the Public Health Service resulted in velocity findings shown in chart No. 1. By making adjustments of the dampers and stopping up of some of the ducts of the old system which had been left open, a gradual improvement was obtained until finally the air motion was reduced to 30 feet per minute.

Bacteriological examinations at 22 different stations in the House showed an average reduction of bacterial content of air by 50 per cent over the tests made with the old ventilation system in 1924. It is interesting to note also that the bacterial count of the wash water is less after a period of use than after a shut down. It is believed that the oxygen in the air has helped to kill some of the bacteria present in the wash water by the intimate contact between the air and water. Molds, however, are increased in the wash water during use and are found on cultures taken in the supply ducts after the air leaves the machine. For this reason the wash water has to be renewed after several hundred hours of operation.

Kata thermometer readings are frequently taken over different parts of the system to see that no serious variations occur.

Recent articles by Leonard Hill and S. F. Dudley emphasize that successful ventilation depends upon more than one factor, and that to ventilate properly any space, dry-bulb air temperature, wet-bulb air temperature, and wet and dry bulb kata readings are necessary. Humidity, temperature, and air motion are the interrelated factors of successful ventilation, and sometimes more than necessary air with the correct amount of humidity can be introduced into a living space and cause unsuccessful ventilation because of the lack of air currents to carry away the emanations of the human body and to assist in the evaporation of sweat.

Another factor introduced in the operation of the present system is the physical condition of the Members themselves. They fit in our statistical age group of "over 50" and hence have the lessened powers of resistance common to the group. They also come from many climates, and the Member from the South or Southwest does not stand too great a rate of change, especially in the summer when the cool dry air in motion rapidly evaporates the moisture in the skin and clothing. However, after sitting still for a few moments until the skin and clothing become dry the sensation of chill disappears. A drop of only 7° with a humidity of approximately 50 per cent has been the cause of complaint (outside air 86, inside air 79), yet frequently in motion-picture houses differences of 20° to 30° are main-

tained and are advertised as a drawing attraction. This great drop can only be condemned, for the circulatory change is too great, and, except in the young and vigorous person, is likely to start an acute illness. The reaction on leaving these excessively cold places is always depressing and is always in proportion to the relative humidity and velocity of the outside air.

The new equipment provides a change of air approximately every five minutes. It seems to have made attendance on the sessions of the House less of a strain on the Members, and the number of quorum calls, in the opinion of some of the House attachés, seems greatly reduced. Members can now sit through the entire day's session without the headaches and depression from which they formerly suffered. Numerous favorable comments have been received from the Members, and one might be quoted who said, "It's the best thing that's ever happened to the House."

I wish to thank Mr. David Lynn, Architect of the Capitol, and his staff, and Mr. Stirling Eagleton, the air engineer in charge of making the new installation, to whom I am indebted for their cooperation in conducting tests of the new systems, and for their supply of much important data. Also, I am indebted to the personnel of the Naval Medical School who performed the bacteriological examinations.

TABLE 1.—Air bacterial counts, House

	Colonies per plate					Colonies per plate			
	May 18, 1929		May 31, 1929			May 18, 1929		May 31, 1929	
	Red	Gray	Red	Gray		Red	Gray	Red	Gray
Seat 110.....	1	2	1	1	Seat 413.....	2	2	0	7
Bill clerk.....	0	1	0	1	Seat 451.....	0	1	0	3
Democratic table.....	0	1	0	1	Seat 397.....	0	2	0	3
Seat 205.....	2	1	0	1	Seat 330.....	1	3	0	13
Seat 223.....	0	0	1	3	Republican cloak room.....	7	11	1	10
Seat 182.....	4	2	1	5	Democratic cloak room.....	10	7	3	7
Speaker's lobby:					Exhaust from floor 1.....	0	1	8	4
East.....	3	6	0	0	Exhaust from floor 2.....	0	0	2	2
Center.....	0	6	0	3	Gallery supply.....	3	10	1	1
West.....	5	8	0	1	Floor supply.....	1	9	1	7
Readings clerk.....	1	3	0	4	Outside air.....	5	2	0	3
Reporters' table.....	2	3	0	1					

TABLE 2.—House air wash water

Before run, Aug. 21, 1929.....colonies per cubic centimeter... 190,000  
 After run of 6 hours, Aug. 21, 1929.....do..... 1,656

All white growth on litmus agar. (Air-borne spore forms.)  
 No pink colonies in either test.

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- Report No. 1980, Fifty-third Congress, third session, House.
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#### REPORT OF MOSQUITO SURVEY IN ST. CROIX

By T. H. HAYES, Lieutenant, Medical Corps, United States Navy

The migration of Porto Ricans to the island of St. Croix began about December, 1926. Hookworm infestation and malarial infection are quite prevalent among the inhabitants of Porto Rico. With the arrival of these immigrants, many of whom harbored both parasites, a new hookworm problem was presented to the medical department of this island. In a report submitted to the medical aide regarding the hookworm issue the malaria hazard was also mentioned.

Except for an occasional sporadic case it has been many years since malaria has occurred on this island. This statement is verified by the yearly health reports from St. Croix, by hospital records since the transfer of the Virgin Islands from Denmark to the United States

in January, 1917, and by information received from those who have been familiar with health conditions of St. Croix over a period of years prior to the Danish-American transfer. It may also be mentioned that the rarity of malaria in St. Croix has frequently been commented upon by naval surgeons who have been stationed in these islands.

In the cases of malaria which our present records reveal—that is, those cases which have occurred since the islands were transferred to the United States—it is noted that the patients had been in some country where malaria is endemic just before they were attacked. From these records, at least, it could not be proved that a single case of malaria had been transferred from one patient to another on the island of St. Croix prior to 1926, when the influx of Porto Ricans began. Malaria began to manifest itself among them soon after their arrival and this incident was followed by a series of cases among natives who had never been away from the island.

It has been suggested on several occasions that malaria of a very low grade is latent among the natives here. If this were true, I am sure that a higher positive spleen index would be noted in the great number of patients passing yearly through the clinics, and the blood smears taken over a period of several years would not have been so regularly and uniformly negative. From the standpoint of clinical and economic importance, it must be stated that until early in 1927 malaria occurred so rarely in St. Croix as to be negligible.

Reports have been issued from this island disclaiming the presence of *Anopheles* mosquitoes. In the year and a half prior to reading these reports the writer had been steadily engaged in the study of the mosquitoes there as a hobby, and having examined over a thousand imagos, among which were many specimens of the *Anopheles albimanus*, was already familiar with facts to the contrary.

A report from the agricultural experiment station on St. Croix, published in 1921, states, "The *Anopheles* and the yellow-fever mosquito are rarely found in St. Croix." Before reading this report the writer had already made personal observations which revealed that the *A. albimanus* was breeding freely in many areas throughout the island the entire year and in numbers sufficient to constitute a menace in the presence of an active malarial reservoir. As to the yellow-fever mosquito, it will be mentioned in its proper place.

The active malarial reservoir was introduced with the Porto Rican. The carrier or insect vector was already present. The chain of events necessary for successful infection was thereby completed following which the actual transference of malaria from one patient to another on St. Croix was actually proved in several cases. While some cases occurred among individuals scattered throughout the

island, the great majority were from the Porto Rican labor colonies and all of the Cruzian cases were from areas heavily inhabited by Porto Ricans.

Communication with the commissioner of public health in Porto Rico showed that in 1925 the malaria index in the Fajardo district and in Viequez was 33. Measures were introduced at that time which, as stated in the annual report of the commissioner to the Governor of Porto Rico, June 30, 1926, are reducing the above figure considerably. This statement is of importance because most of the Porto Ricans living in St. Croix had migrated from these areas.

Other factors had to be taken into consideration. First, Porto Ricans were continuing to come into St. Croix and, while some of the unstable or fly-by-night element were returning, a good percentage were settling down to stay. From the very beginning of this immigration I had pointed out definite indications of permanency among them, and in retrospect while writing this article we see those predictions justified to some degree. Secondly, at the time this problem arose there was nothing on file in the sanitation department to indicate the location, extent, or character of Anophelinæ breeding on the island. There was no information as to potential breeding areas. The only mosquito-control activities being pursued to any extent were general measures confined to the immediate vicinity of towns with particular reference to the more domestic breeders. This activity represented the remnant of work directed against dengue and Filaria in years past, and was not being carried out on schedule or according to any systematized plan. It had been delegated to a native inspector who had a thousand other detailed duties and consequently it can hardly be said that the work was effective to any great degree.

One exception must be made to the above. From 1917 to 1920 there is every indication that more attention was paid to prevent the breeding of wild rather than the domesticated mosquitoes, and rural streams were planted with the top feeding fish, but since 1920 there is no evidence at hand to show that the rural areas have had any semblance of organized mosquito control. Record shows that from about 1902 to 1903 Schmiegelow, the manager of the Danish Plantation Co., introduced great numbers of the top feeding fish (*Lebistus reticulata*) from the island of Barbados and planted them in many of the streams throughout the island.

Thirdly, the island has an area of approximately 84 square miles, composed mostly of rural districts, all parts of which are not easily accessible. The Porto Rican immigrants scattered among the Cruzian population throughout the length and breadth of the island. To survey this area for Anophelinæ breeding and to institute control



measures, to inspect the various communities for the acutely ill in order to isolate and treat them as soon as possible, and to attend to the many finer details of organization necessary to a successful anti-malarial campaign, constituted the field work which devolved upon the department of sanitation. For this work the department had available one native sanitation inspector in Christiansted, whose routine daily duties were many and varied, and one first-class pharmacist's mate detailed as sanitation officer, with supervision over numerous activities. Less than 1 per cent of all the Porto Ricans to be dealt with understood English, and the department had only one man who spoke any Spanish.

It should be mentioned that a work of this nature is not one in which the temporary concentration of present small forces would be of any lasting advantage. A crisis had not been reached which demanded attention at the expense of other important work then in progress or a wholesale rearrangement of the established routine. Serious, careful, and, above all, persistent attention to this matter of mosquito control was indicated in addition to the other problems with which we had to deal.

Every medical officer on the island assisted in this work to some extent, and the Navy nursing staff contributed valuable service, helping to relieve the personnel situation. It was plain to those of us on the ground, however, that we could not expect to see the work completed within our regular tour of duty.

The only vehicle in the transportation department was one inadequate, worn-out, asthmatic light car of a popular make, which had been converted into a small truck. Cars belonging to members of the staff and operated with gasoline provided by the owners, the car assigned to the chief municipal physician, the car belonging to the American Red Cross, and the ambulance of the Christiansted hospital were placed at the disposal of the sanitary department at various times and helped to overcome the deficiency in transportation.

These small but most important details are never in evidence and are never mentioned in annual reports.

The medical department in general was made "malaria conscious." All Porto Ricans passing through the hospital for any cause were examined for malaria, all patients who harbored malarial parasites were thoroughly treated, and their follow-up treatment was checked by members of the district ambulance service. The personnel of the district ambulance service were instructed to pay particular attention to the sick in the villages and those acutely ill were urged to enter the hospital. It may be stated here that the district ambulance service operating from Frederiksted has been most efficient but that from

Christiansted over the same period of time has been practically negligible. To make up for this deficiency the chief nurse has made frequent trips in her own car to the district villages on these missions.

In order to keep a detailed record of the work accomplished, the hospitals at Frederiksted and at Christiansted sent a weekly report to the sanitary officer. This report gave the number of Porto Ricans examined and the number found to be infected with malaria. Each medical officer in addition notified all cases of malaria coming under his private care, stating the location, probable source of infection, nationality, and final disposition of the case. Although malaria is a reportable disease in St. Croix, the writer had no cognizance of any case which had been reported by the local practitioners on the island. The cooperation of the two local practicing physicians was therefore solicited.

Personal contact was made with Porto Ricans in their villages, just as in the hookworm campaign. They had already been "sold" on the great value of early medical attention by their experience with the department during the previous campaign directed toward the control of hookworm infestation. This element of personal contact works wonders with the Porto Rican and is well worth the time spent. It was gratifying to note that every patient who came to our attention in Christiansted had made his own contact with the hospital, and after being discharged to his home had dutifully returned for observation and follow-up treatment. It was the custom of the Porto Ricans to come into town every Saturday for the purpose of buying provisions. Many of them arrived early with the intention of visiting the hospital in order to report to the doctor or to bring a friend who had recently arrived and who needed medical attention or a physical examination.

Educational meetings were held in the various communities throughout the island, at which malaria, its mode of transmission, the necessity for early isolation, and thorough treatment of those affected were explained in detail by the chief municipal physician. These meetings were well attended by the general public and it is believed that they served their purpose.

While it was recognized that control of breeding and eradication of the anopheles mosquitoes was necessary to prevent the spread of malaria, a careful study of the subject revealed the fact that data relative to the distribution of mosquitoes on the island was lacking. There was an apparent need of a complete mosquito survey of the entire island, the results of which might form the basis for a constantly continued and prolonged campaign against the mosquito, and the findings permanently recorded in some systematic manner. A classification of the *Anophelinæ* found and a study of their habits was therefore indicated. Aware of the fact that such a work as mos-

quito control and eradication is a long process requiring the patient and persistent application of known scientific principles, the great importance of recording all noted facts or control measures placed in effect was emphasized from the beginning in order that a complete record might be available for succeeding administrations and a repetition of the work avoided. This issue was kept fully alive and its achievement represented our goal.

While the survey was undertaken with *Anophelinæ* as the main objective, it was thought expedient, owing to the prevalence of filariasis and dengue in St. Croix, to include the other varieties of mosquito life in our study, thus making the survey more general in character.

The map taken as the standard guide in this work was the Coast and Geodetic Survey Map No. 3242, published in 1923, and which has a scale of 1 to 4,000. From a study of the map it may be noted that the island is composed of a high northwestern elevation and a high eastern triangle with a central connecting coral plane running roughly from northeast to southwest, which is broken near the center of the island by an occasional small rise. The extreme southwestern portion is an unbroken flat gently sloping to the sea on the south shore. The eastern triangle is practically devoid of permanent watercourses. Drainage from this area is by means of steep gravelly gorges through which the surface water races rapidly to the sea immediately after a rainfall. Pool and basin formation is not ordinarily found along these gorges.

The source of most of the watercourses on the island is in the high northwest elevations, but the actual water-holding areas are naturally to be found in the central plane. The gentle slope of this area slows the flow of the streams and resulting deposit of silt tends constantly to alter their course and form small pools.

Besides the flowing streams, there are several drainage areas and pond formations to be noted. Attention is invited to the accompanying small-scale map with its attached legend which gives some idea of the natural water-holding areas considered in the survey.

All of these water-holding areas were carefully investigated and dippings were made for mosquito larvæ. While all varieties of larvæ and the location in which they were found were noted, the areas producing anopheline larvæ were indicated in red on the map. Along with the posting of the map, a detailed set of notes was compiled directly from the memoranda made in the field by the inspector, and filed in such a way that as subsequent inspections were made and mosquito control measures introduced or checked, notation to that effect could be added.

As the survey progressed, more sizable collections of water were found than was indicated on the standard Geodetic Survey map. In

some instances these collections of water consisted of streams which were considered too small to be shown on a map of this scale and in other instances streams had changed their course since the original map was prepared. Corrections were accordingly made on our copies of the map and these new streams and other water-holding areas were indicated in green.

There were certain features of this survey that are worthy of mention. The entire area was covered by the same person and, while he was aided by others on different excursions, the fact that a single individual actually traversed the area and became familiar with local conditions tended to increase the value of the survey especially in regard to consistent interpretation of the findings. Dippings for mosquito larvæ were made in most instances at intervals of not more than 10 yards along each side of the streams, and as this procedure was carried out from the stream bed proper rather than from the banks, both borders were readily accessible.

During the period of time from January until July, 1928, while the survey was being made, an unbroken drought was experienced. The opinion was expressed by many old-timers that as little fresh water will rarely again be encountered on the island at this time of the year. From this state of affairs it may be assumed that our findings do not give an exaggerated index of Anopheline breeding but represent a fairly true minimum.

In conjunction with the work outlined above, the various estates were visited and the owner or manager of the estate interviewed. Efforts were made to render him "mosquito conscious" and to secure his hearty cooperation and interest. During the visit all impounded water supplies, such as ponds formed by the construction of dams, reservoirs, and cisterns, were inspected for mosquito breeding, actual or potential. The findings in each instance were entered on another map which may be regarded as a spot map. The location of the estate was marked by a pin to which was attached a small cardboard square for every collection of water found on the place. Blue squares were used to indicate that mosquito breeding was under control and red to indicate that no control measures were in force. In addition, all squares were appropriately marked. Thus, a pin bearing two blue squares marked "C," one marked "T," and one red square marked "D" would tell at a glance that estate "X" has two cisterns, one dam, and one tank. Furthermore, that mosquito breeding was under control in the cisterns and the tank, but that control measures had not been applied to the area above the dam. On subsequent visits questions are asked particularly in regard to the condition of the dam. If it is learned that this area, which was dry at the time of the previous inspection, now holds water, measures are introduced

to control mosquito breeding, and the red square attached to the pin on the map is exchanged for a blue one.

Depending upon rainfall for its water supply, as this island does, inspection of the impounded water, while a great task, forms a very important part of mosquito-control activity. This phase of the work, as will be shown later, is important not only from the standpoint of present anopheline breeding but as a control measure against the more domesticated mosquitoes. It should also be borne in mind that as the streams are rendered more uninhabitable for larvæ, anopheline mosquitoes may be expected to seek near-by artificial collections of water in which to lay their eggs.

A search for small receptacles capable of holding water was included in our investigations. Rural villages were visited and notes made of rain barrels, gasoline tins, pots, kettles, tin cans, defective water spouting, broken bottles, water-holding plants such as elephant ears, old palm fronds, and the like. Under this heading, water-holding receptacles ordinarily found within the house proper such as flower pots, bathroom drains, shower tanks, toilets, and poorly draining bath floors were also considered. Mosquito-breeding hazards within houses in rural districts were always investigated conjointly with the inspection of dams, cisterns, and other impounded water supplies about the premises.

Cesspools and similar sewer and waste pits were inspected as a separate part of the work. This was a late phase added to our survey after the return of the writer in June from Porto Rico. While in San Juan, the writer accompanied Dr. William Hoffman, of that city, when he lifted the covers of a dozen or so poorly constructed sewer traps located in the heart of the city, and was thus able to reveal to the city health department the source of the pestilence of the so-called dry-breeding mosquitoes.

Great numbers of larvæ caught in the dippings were brought to the laboratory from each area inspected for the purpose of hatching and, in addition, live imagos from dwellings, stables, and outhouses located in various parts of the island were collected for identification and further study. Catching tubes containing chloroform were distributed among those interested in the work and their catch forwarded to the laboratory.

While the aridity of St. Croix is always spoken of with respect to cane growing, the amount of fresh water found to be actually present on St. Croix would surprise many of the oldest inhabitants. It is true that dry areas were encountered in some portions of the watercourses inspected, but nevertheless the relative proportion of the stream bed holding water of some depth was great. On inspection tours it was not unusual to wade through water waist deep. More important, however, is the fact that where water was encoun-

tered, it was the rule and not the exception to find evidence of *Anophelinæ* breeding. In many of the areas anopheline larvæ predominated above all others in the open streams.

As implied in the geographical description of the island, the maximum amount of water was encountered in the central level plain. It was in this portion of the island, where the majority of the Porto Ricans are located, and from which most cases of malaria have been reported, that the largest number of anopheline larvæ and mosquitoes were found.

A study of the map showing the *Anophelinæ*-producing areas also revealed the fact that the concentration of larvæ and mosquitoes decreased progressively from the central and more heavily populated districts toward the less densely populated and higher areas to the north and south. Where habitations were relatively numerous larvæ were constantly found in streams, while in the more sparsely settled districts they were confined to small definite areas in the beds of the streams, even though water was found throughout the length of each watercourse. These localized areas were most frequently seen at cattle fords and near corrals or water holes used by cattle. It may also be stated that in every instance larvæ were more abundant in that section of the stream nearest the habitations. The stream beds were always choked with vegetation and débris, the banks overgrown with tropical plants and in most instances the flow of the water was very slow. These observations are in accordance with findings made previously by the writer while working with related species of mosquitoes in other latitudes.

The writer has heard the late Dr. H. R. Carter, of the United States Public Health Service, who was a great student of what might be termed "mosquito psychology" and philosophy," remark many times that, with other factors being equal, the female would lay her eggs every time nearest the most favorable blood supply, and that the nearness could be measured by inches. The results of our recent survey would certainly seem to confirm this observation. It was frequently noted in streams of greater length that long stretches might remain entirely free from indications of *Anophelinæ* breeding and then a heavily infected section would suddenly be encountered. There was no apparent difference in the environment. The character of the water, the exposure to sunlight, the surrounding vegetation, and the condition of the contiguous banks might all be the same and yet the larvæ would be concentrated in small areas. This would at first appear as though the female *Anophelinæ* were carelessly laying all her eggs in one basket. However, upon closer investigation it was invariably learned in these instances that with increasing or protracted drought these particularly infested sections of the watercourse are the ones known to retain their water the longest.

Cool water and moderate shade seem more conducive to anopheline breeding than warmer water and direct sunlight. Relatively clean water gave more positive findings than dirty or clouded water. Heavy breeding was always found in grassy areas.

No salt-water anopheline breeding was found, but the most extensive breeding observed in any one area was in a slightly brackish pond which had been diluted by rains and seepage from the hills. Chemically contaminated waters, such as those containing the refuse from industrial plants (sugar factories and alcohol plant), were absolutely negative for anopheline breeding.

All of the natural water-holding areas which were inspected exhibited one or more of the known natural enemies of the mosquito larvæ. Perhaps the most effective of all natural enemies of mosquito larvæ is the top feeding fish. In many of the areas inspected the guppy fish (*Lebustus reticulata*), otherwise known as the rainbow fish and commonly called by the laity "Millions," was found. The fish is indigenous to many of the West Indies, principally the Barbados, and, as has been stated before, was imported to St. Croix from these islands for use in the streams as a mosquito-control measure. The males of this variety of fish are beautifully marked in brilliant color and were at one time used for ornamental purposes only.

Wherever these fish were noted in the streams under inspection, a marked lessening of the anopheline breeding was noted. Wherever breeding continued profusely in spite of the presence of many fish there was always enough débris or floatage to prevent the fish from successfully reaching their quarry. With very few exceptions, no area inspected could be considered as adequately supplied with fish. These fish were never found in brackish water. In some instances the stream contained great numbers of fish and no larvæ could be found. At the same time many depressions such as might be made by the hoofs of cattle and containing water were found on the contiguous banks. Prolific breeding was found in these collections of water to which the fish obviously did not have access.

Where the stream proper showed great numbers of fish and no larvæ could be found, if there occurred at the same time on the contiguous banks a wet small water-holding area such as might be made by cattle, these areas on the side to which the fish do not have access would be profusely breeding.

Fresh-water Hydra are to be seen in some of the streams and in some places are present in sufficient numbers in some locations to have an inhibitory effect on mosquito breeding. Along many of the stream courses, especially those which are heavily overgrown with vegetation, many spiders are encountered. Arachnida doubtless form a second line of defense against the mosquito, inasmuch as those larvæ

which do successfully hatch are often destroyed by spiders. On inspections a great number of adult mosquitoes could be seen trapped in the huge spider webs which were stretched among the trees and bushes which grow in profusion along the borders of the streams. It might be mentioned here that the jumping spiders often found in the houses in the Tropics (genus *Salticus*) are very effective in reducing the number of mosquitoes within the house.

Many small harmless insectivorous green lizards may be found jumping among the foliage of these stream banks. They are very active as destroyers of mosquitoes but, as in the case of the spiders, belong to the second line of defense.

Predatory water beetles are present to some extent in nearly all areas inspected. Dr. J. B. Smith believes that the larvæ of one form of water beetle (*Dytiscidæ*) are among the greatest enemies of the mosquito. Galli-Valerio and Rochaz de Jongh found that an adult water beetle (*Dytiscus marginalis*) destroyed great numbers of mosquito larvæ and pupæ. Whirligig beetles (*Gyrinidæ*), according to Doctor Smith, live almost entirely at the surface of the water and are extremely predaceous toward anopheline larvæ. This type of beetle may be found along the streams on the island.

Many dragon flies are found about the natural water-holding areas. They feed upon the adult flying mosquito while their larvæ feed upon the larvæ and pupæ of the mosquito.

While there are certain mosquito larvæ which are known to be cannibalistic in their habits no such evidence was found during inspections here.

Fresh water algæ of types known to be deleterious to mosquito-breeding were never noted in our inspections. No bladder worts were encountered, although their presence in the island of St. Croix had been mentioned in a botanical report from this island.

Small crayfish and fresh-water shrimp are to be found in practically all the streams inspected and it is generally believed that these organisms are deleterious to mosquito larvæ and pupæ.

Several varieties of salamanders are noted in the streams which probably have some minor effect as a controlling factor.

As stated before, great numbers of anopheline larvæ were brought in from each area inspected and hatched in the laboratory in especially constructed aquaria to resemble as closely as possible the particular source from which they were obtained. The total number of anopheline larvæ so hatched was 1,112 and with one exception the larvæ developed into the *Anopheles albimanus* mosquito in every instance. The exception occurred late in the survey when three larvæ out of 108 taken from the water just above Creque Dam proved to be *A. grabhamii*. Special attention was directed toward finding more



of these larvæ but only one more was found in the Creque Dam area, the original source, and none were obtained from any other part of the island.

Equal numbers of Culicinæ larvæ were collected and brought to the laboratory from the natural watercourses. The predominating mosquitoes other than anophelinæ were the *Culex quinquefasciatus* and *Aedes ægypti*. In a few brackish pools *Aedes*, believed by the writer to be the *Aedes portoricensis*, were found in large numbers. *Uranotania socialis* was found in the more isolated watercourses on the north side. It might be said here that mosquito breeding other than anopheline breeding was found throughout the natural waterholding areas, but Culicinæ breeding in the natural areas predominated only where the water was more or less stagnant, dirty, hot, and sometimes malodorous. Crab holes along the banks of these watercourses are all producing mosquitoes profusely, but time did not permit of their study.

The *Anopheles albimanus* averages about 4 millimeters in length of body (female) and is grossly recognized in the field by the wing spotting and the "white feet." Tipping the "white feet" may be seen a terminal black segment. Also it must be recorded that 17 specimens were examined which seemed to show much more white in the coloration of the palpi than was found in the great majority of the Anophelinæ examined. Similar findings have been previously reported from Barbados, Antigua, and Granada. The name of *A. tarsimaculata* was given to this species by Goeldi, and it was supposed to exist along with the *A. albimanus* in areas north of Panama. It is possible that these mosquitoes have been brought in by ships from the other islands. The *A. albimanus* is recognized as a most efficient host of the malaria parasite. This mosquito is described as one in which the blood-sucking habit is highly developed.

It will be recalled in our survey, as our field of investigation left the more densely populated areas, the larvæ became fewer in numbers. This is characteristic of the breeding habits of mosquitoes with more intensive blood-sucking propensities. However, in the Creque Dam area, where the blood supply is more limited, the writer has repeatedly shown a diminution of this blood-sucking propensity. Females as well as males may be observed feeding upon fruits and mango seeds and constantly ignoring a blood supply which was offered them at their known favorite feeding times.

Larvæ were brought in from these areas where the blood-sucking tendency of the adult seemed diminished and, when hatched in our aquaria, the resulting adults exhibited just as much blood-sucking propensity as those hatched from larvæ dipped from more densely populated areas. Thus it seems that the loss of the blood-sucking propensity is an adaptive measure of a single generation.

The *A. albimanus* has been reported as preferring brackish water. Quite the opposite has been found in our work here. Other workers report their preference for dirty and malodorous areas. Neither has this been in evidence in St. Croix. This mosquito is a very adaptable organism, and when conditions render it necessary the albimanus will breed in any water-holding area, but its preference is cool, clean, very slowly moving water and pools with grassy environment and containing plenty of Spirogyra.

By experiment over a period of months we have been able to show the preference of the female *Anopheles albimanus* as follows: First, aquaria with fresh water with natural stream-bed constituency, free from the top feeding fish and uncontaminated by chemical or waste products; secondly, very similar aquaria, except containing slightly brackish water; third, an equal preference between natural fresh water with the fish present and very brackish water; fourth, a tap water aquarium free from fish. We were never able to get a hatch of *A. albimanus* in aquaria contaminated by sewage, fermentation products, or borax.

The *Culex quinquefasciatus*, however, seemed to revel in most putrid areas. Our greatest hatches of this mosquito were obtained in cesspool aquaria and in the diluted refuse from the alcohol and sugar factories.

In these experiments it was noted repeatedly that while the mosquito fish were very active against anopheline larvæ, they were much more active in the destruction of *Culex* egg rafts than they were in their destruction of *Culex* larvæ. I have repeatedly seen the fish fight and scramble for the *Culex* egg rafts, totally ignoring the larvæ present until all the egg rafts had been savagely attacked and gulped.

It was also of notable interest that the fish exhibited a distinct preference for anopheline larvæ. When *Aedes* and *Culex* larvæ were present in aquaria with anopheline larvæ, the fish would ignore the first two mentioned and seek out the Anophelines. I have seen them time and again butt the large Culicinæ larvæ out of their way to reach an Anopheline. In the course of several hours' observation at an aquarium I have seen the fish feed upon Culicinæ and in most instances engulf the larvæ head on and bite them off at the terminal siphon, leaving that fragment free. The siphon probably, at times, offers mechanical difficulties to deglutition.

General observation of the adults showed that anopheline breeding in the islands is a steady, constant process. In other latitudes where the seasons are sharply marked, breeding is in waves as with floods following a spring thaw. In St. Croix the environment is not fluctuating enough to produce emphatic seasonal breeding. The adverse

conditions experienced by the mosquito here are largely periods of drought, which will lessen the activity to some extent but never seriously impede their steady, even production. The adults resist moderate droughts without difficulty. This seasonal outburst of mosquitoes is what gives some localities the reputation of being terrible pest areas, and it is the absence of such outbursts in St. Croix that minimizes the attention given to anopheline mosquitoes on the island.

The more domesticated breeders, such as the *Aedes aegypti* are different in this respect. After any slight rainfall these house and yard breeders will appear rapidly in large numbers and become a great nuisance. Contrary to the general belief, these mosquitoes, if they do not find water in which to lay their eggs, will make ovideposits in dry spouts, dry water containers, and house and yard plants. Their eggs seemingly will resist desiccation a long time. When it does rain and moisture is supplied, these eggs appear to develop much more rapidly than others; hence, a great postpluvial outcropping of the little black and white domestic mosquitoes will overwhelm the household.

A small very brackish (even salty) reach was observed to hold vast numbers of *Culex* egg rafts but persistent dipping showed only an occasional larva or pupa. A rain would come and a few days later great numbers of larvæ, pupæ, and adults could be recovered while the egg rafts would be correspondingly reduced. The water would become almost fresh from dilution. It would appear that the quality of the water was not right for development of those rafts, but the female would nevertheless deposit her eggs, anticipating future dilution which would allow hatching.

Adult Anophelinæ could very rarely be found within human dwellings. A careful search under beds, in clothes closets, and protected corners very rarely revealed specimens. Stables, corrals, out-houses, and pigsties, however, gave the greater yield.

This is of interest in relation to a series of brilliant and well-controlled experiments carried out by Earle in Porto Rico at approximately the same time we were working in St. Croix. Earle definitely showed that the *A. albimanus* and *A. grabhami* distinctly preferred blood of the lower animals, particularly that of oxen and horses.

In our work we had frequently recovered great numbers from cattle and horses. In native villages where the thatched cattle pens were close to, but in the lee of, the dwellings, the adult was never found in the dwelling. This observation recalls the concentration of larvæ in the streams near cattle water holes, fords, and pasturage areas mentioned previously in this article.

The feeding time of the adults was investigated. This was carried out by exposing two people, for 2-hour intervals, 63 different

times in areas where a known species was known to abound in predominating numbers. In addition to this, two of us have spent days and nights exposed, and the alightings and bites of the different varieties were recorded. Our interested and informed friends were requested to leave their bed nets undraped occasionally as they rested and observe for us. While sitting in their quarters they would note the species biting before striking and attempting to kill the mosquito. It is true that these findings have great source of error, but these reports checked so well with our recorded sixty-three 2-hour exposures that we feel justified in reporting our findings. It was found that *Anophelinæ* fed just at dark. The maximum number of bites in the wooded sections were recorded just before dark. Bites from *Anophelinæ* within houses were mostly recorded as occurring just at sundown or before dark. As a matter of fact, we found it hard to get *Anophelinæ* to bite under the most ideal conditions.

*Aedes aegypti* were most regular and businesslike in feeding habits. They were always active just after daybreak and most vicious about 3 to 4 o'clock in the afternoon. They were bold in attack and if disturbed ducked and rushed back for a continuation of their feeding. They attacked in numbers, fed rapidly, but never seemed to alight completely and fix themselves for feeding. They did not resent being watched under the glass and gross movements of the arm or leg upon which they fed apparently did not bother them. The leg would be raised as they filled with blood and waved vigorously as the feeding neared completion. This leg waving movement was noted in the other mosquitoes also but in the *Culex* it seemed to be slower, more rhythmic, and not so violent.

An interesting observation was made regarding this species. With the females there would be as many and often more accompanying males. The males would alight and drink from the moist perspiring surface of the body while their mates were feeding. When the blood meal was completed the females would dash off exhibiting the same vivacity with which they had come.

The *Culex quinquefasciatus (fatigans)* was revealed as an "all-night" biter but all biting ceased as daybreak approached. Day bites, however, were not uncommon in our 2-hour exposures and were mentioned in the reports received from our observing friends. This species impressed me as being a most bored and blasé individual, lazy and indifferent, and also timid and indecisive. The female would slowly zigzag up to our environment and alight near a feeding surface, fly around sluggishly and almost alight and then change her mind and fly away. Sometimes she would alight and rest a moment and then move off. If one moved, she would leave, but not hurriedly, and stay at a safe distance for a long time and then slowly return.

Many times she would wait till others arrived and then return. She fed slowly but once started would gorge herself to a greater extent than the other varieties. Invariably this species would not fly any great distance but would alight very near by after feeding and rest. They seemed too heavy to move and could be collected or killed with the greatest ease after their meal. They were never vicious. This species could always be found in great numbers on bed nets in the morning.

The swarming propensity does not seem to be highly developed in the above three species. I never witnessed a real swarm of mosquitoes during my entire tour in the Virgin Islands. The *Aedes aegypti* will collect in small groups of 8 or 10 about a telephone battery box or under a table in the shade and weave about, but I have never witnessed actual swarming as may be seen about a steeple or telegraph pole during summer twilight in most any rural district in the United States.

The more one studies these three predominating types of mosquitoes in the Virgin Islands, the more apparent does it become that these insects possess an unusual knowledge of man's habits. Especially is this true of the *Aedes aegypti*. They possess an uncanny knowledge of the daily activity about a human habitation, can pick out receptacles that hold water the longest, can pick out the places that are sure to ultimately hold water, and in many other ways exhibit astounding strategy and judgment for the completion of a hatch of the maximum number of eggs.

A general summary of the findings in the inspection of impounded waters should be given. As has been stated before, this island, depending as it does upon annual rainfall for its water supply, necessarily requires a great number of individual cisterns, dams, reservoirs, and catch basins, not to mention the smaller water-holding receptacles. In the rural districts each estate has its individual water supply.

Open dams exposed to direct sunlight, free from algæ and floatage, whether or not stocked with fish, revealed very little breeding. The closed cisterns of the semiunderground type were the heavier mosquito producers. The predominating mosquito found in this type of cistern was the *Aedes aegypti*. This type of mosquito seems to be particularly irritated by sunlight, and immediately upon opening the cistern most of the larvæ dive to the bottom or retreat to the darker corners and away from the open hatchway. Unless deep dipping is done in these cisterns very few larvæ will be obtained.

The *Culex quinquefasciatus* (*C. fatigans*) was the other mosquito noted in large numbers in impounded waters. This mosquito seems to predominate in the dirtier and less frequently used old cisterns and large tanks located in more isolated areas such as in the fields or

pastures near cattle corrals in contradistinction to the *Aedes*, which predominated in water containers in close proximity to villages and estate dwellings.

In many instances the containers showed vast numbers of *Culex* egg rafts, and while no *Culex* larvæ were discernible, great numbers of *Aedes* larvæ were found. These *Aedes* larvæ were repeatedly allowed to mature in order to further verify their identity and to distinguish them from the *Culex*. Some factor which might be deleterious to the *Culex* hatching, but not to the *Aedes* development was sought, but no satisfactory explanation could be found. With only one exception, Anopheline larvæ were never found in impounded water collections, and that exception was a large catch basin at "Barren Spot." A single anopheline larva (*A. albimanus*) was picked up in the routine dipping in this location.

The general condition of the cisterns, tanks, etc., throughout the rural districts was not exceptionally good. In many cases the bricks or cement had crumbled and left open gaps. Inlets and overflow outlets were either imperfectly screened or not screened at all. Air vents were oftentimes unguarded. The manholes were imperfectly covered either by broken screening or rotted wooden covers which were poorly fitted. Manhole covers which had primarily worked on a hinge were either detached from the cistern entirely or halfway so. Where pumps had been installed through cistern hatches, the pump well afforded good breeding places.

Very few of these impounded water supplies had any fish whatsoever, while a few others were inadequately stocked. In the few instances in which the fish were adequate in number mosquito breeding of any kind was negligible.

Live imagos collected in houses near these water containers were found to be identical with those emerging from larvæ found in the water.

Wells are considered under impounded waters for purposes of this survey and report. It was unusual to find breeding to any extent in wells on this island; however, the degree of salinity or lime in the well water did not seem to exert any influence. When breeding was found in wells, it occurred in those which were shallow, unused to any extent, and full of débris and floatage. The predominating mosquito larvæ found in this location were those of the *Culex quinquefasciatus* and a few of the semidomesticated or woodland variety of the *Aedes*.

The town reservoir of Christiansted revealed no breeding. While this reservoir is unscreened, it is adequately stocked with fish, and repeated dipping has failed to reveal one mosquito larvæ of any kind.

Inspection for breeding in small receptacles revealed the fact that practically every village throughout the island harbored many small pots, gasoline tins, rain barrels, and the like, all holding water and practically all of them containing larvæ. There was a marked absence of any attempt of control. It was noted repeatedly on these inspections that breeding rarely occurred in the open iron pots used for cattle troughs. This is probably due to the frequent disturbance by the cattle drinking regularly from the pot or to the frequent emptying and refilling of the receptacle. Incidentally these iron pots are usually exposed to the direct rays of the sun throughout the entire day, causing the water to become very warm, even hot.

In a few instances where the pots were no longer used but still held water, together with some algæ and débris, a few *Culex* were found. About the village houses, the rain water used for drinking and washing is chiefly stored in wooden barrels and in numerous gasoline tins. Breeding in water barrels was five times as frequent as in gasoline tins. A small 5-gallon gasoline tin is handled and emptied much oftener than the barrel. The female mosquito apparently is quite cognizant of the fact that the water in the barrel is far more permanent than that in the tin and she will invariably lay her eggs where the chances for a maximum hatch are best. In conjunction with investigation of small-receptacle breeding a general sanitary inspection was made of all the rural villages. With rare exceptions the rural villages were dirty, unkempt. Great piles of refuse were found about the buildings, while the rubbish heaps contained broken bottles and tin cans, most of which held some water and were found supporting larvæ. Tall grass and weeds which harbored the resting adult mosquito showed rampant and uncontrolled growth about the villages. Town properties were but little better and in some instances much worse. The predominating mosquito from this source was the *Aedes aegypti*.

Profuse breeding of the *Culex quinquefasciatus* was noted in sewage traps and semi-closed pits, especially after rains had supplied much surface drainage and they had not been cleaned and emptied fast enough. One of the most profusely breeding sewage traps was found in the government house yard.

It is not uncommon to find the greatest source of mosquitoes about a given dwelling to be within the dwelling itself. Thriving larvæ were found in poorly draining bathtubs, in toilet tanks which do not completely empty on flushing, in old flower urns, and in vases. Disjointed spouting or spouting which sagged, thus breaking the normal fall to the drain, was also a common source.

The conclusions to be drawn from this survey might be stated as follows: The amount of permanent fresh water and potential breed-

ing areas for Anophelinæ are greater in St. Croix than had been believed. The actual breeding of Anophelinæ in St. Croix in all seasons is more than sufficient for the spread and the constant increase of malaria in the presence of a possible human reservoir of malaria. There are certain natural factors in St. Croix which can be of assistance in the control of the Anopheline breeding and which should be encouraged. More attention is needed for the control of the sylvan breeders than has heretofore been given. Absolute eradication of the Anophelinæ is practically impossible for the present, but under the persistent application of scientific measures of control, breeding can be constantly reduced and eventually be rendered a negligible quantity.

The survey shows further that contrary to the report emanating from the experimental station about 1921 or 1922, to the effect that the yellow fever and the malaria mosquito were rarely found in St. Croix, the *A. albimanus* and the *A. aegypti* are commonly found throughout the island, the latter being the most common mosquito found in the towns of St. Croix.

The survey fails to reveal any evidence of the *Aedes variegatus* as recorded by Hughens who considered it to be the responsible transmitter of filaria in this island. While the *Aedes variegatus* has been shown by O'Conner to be the chief transmitter of filaria in Polynesia, this mosquito is distinctly an Old World variety. The writer believes that previous workers in St. Croix were dealing with imperfect specimens of the *Aedes aegypti* which are so common here. Furthermore, there is so much proved evidence regarding the filaria transmitting propensities and capabilities of the *Culex quinquefasciatus*, which are found in great numbers, that it is not necessary to stigmatize the *Aedes* here in order to explain the extensive incidence of filariasis in St. Croix.

Porto Rico attributes filaria transmission on that island to the *Culex quinquefasciatus*. The writer has had the privilege of being in contact with that work in Porto Rico and has been thoroughly convinced of the great part which this mosquito plays in the transmission of the filaria in this latitude.

The survey reveals the importance of rendering the impounded waters more untenable for mosquitoes, not only to reduce the numbers of the more domesticated breeders and to lessen an aggravating pest, but to prevent breeding of the malarial vectors, as has been mentioned before, after the natural water-holding areas are made more uninhabitable for them.

Definitely known breeding areas and their nature have been permanently recorded by this survey and the measures applicable in each case enumerated after due consideration.



The investigation as a whole, of which this mosquito survey was a part, shows that a small amount of funds must suffice to carry on the work. The personnel must be limited and the facilities for carrying on the work are not of the best. These adverse conditions which tend to slow progress must not be considered as sufficient reason to lessen activity in this work. There is enough money, enough personnel and sufficient facilities at hand, which if properly and persistently employed can result in much good.

In order that no time might be lost, while the survey was in progress, corrective measures were introduced along with the investigation procedures. As a result, our map shows that many of the streams and watercourses have been adequately stocked with fish; definite areas are under control by oiling; and many impounded water supplies have been rendered mosquito free.

In conjunction with the work on St. Croix, the writer spent a short time on St. Thomas for the purpose of acquiring comparative data. Lieut. Commander E. Peterson, Medical Corps, United States Navy, during his tour of duty there devoted much time to the control of mosquitoes and left much very valuable data with the department of health in this regard. His work really forms the basis for the present system of control in St. Thomas.

The problem in St. Thomas is quite different from the problem in St. Croix. St. Thomas does not have the great rural area to consider, and there are not the extensive water courses which are found on St. Croix. Control of the domesticated mosquitoes form the bulk of the work in St. Thomas about the towns and near-by rural settlements. Sylvan or rural breeders are to be found, of course, and attention to them is necessary, but their breeding is limited to wells and a few upper reaches of the sea.

The *Anopheles grabhami* was found more frequently in St. Thomas than in St. Croix, chiefly in outlying and deserted brakish wells. The *Anopheles albimanus*, however, was the predominating Anopheline found.

St. Thomas has a very well systematized-control program, and this system reaches its greatest efficiency in the work against the domesticated species. There, in St. Thomas, a medical officer is detailed as a full-time sanitation officer and a staff of inspectors is constantly employed in this work. A regular oiling schedule is carried out, and in those areas which are being oiled regularly no breeding was found. In the outlying districts, however, there are several areas which were stocked with fish in the past; but as the streams have at times dried up in spots, the fish have become poorly distributed, and breeding of *Anopheles* was consequently found.

Another characteristic of Anopheline breeding in St. Thomas which has not been observed in St. Croix was the frequent breeding

of both the *A. grabhami* and *A. albimanus* in water of the most temporary nature. The breeding of *Anopheles* in brackish water as found in St. Thomas was not found in our survey conducted in St. Croix.

There are certain recommendations for the future which the writer believes are worthy of consideration.

In general, the remedial measures for mosquito breeding are divided into temporary and permanent. Under permanent measures are considered such procedures as the filling in of low wet areas or effecting their permanent drainage by efficient ditching and draining or a combination of filling and draining. The latter are not indicated here in St. Croix where the great breeding areas are not in low, swampy, marshy stretches but in the slowly flowing fresh water streams, cattle holes, and a few ponds. The water in which they are found is necessary for cattle and human consumption, for agricultural purposes, and for use in the boilers of commerce. The ideal and desired control measures are therefore those which will destroy the mosquito or prevent their development and at the same time leave the water potable and suitable for commercial and agricultural purposes.

There are two possible exceptions to the above which may be cited, namely, "South Gate Pond" and the poorly draining, "Lawyer Ackers Area." In the latter case, water is rarely there long enough to make it a menace such as to occasion a great outlay of funds for a series of ditches and the installation of a floodgate. During the short periods it does hold water, breeding can be controlled by oiling. The project of permanent mosquito control in the case of "South Gate Pool" is entirely too large to be undertaken with our precious funds, and other measures must therefore be introduced. Again, control measures must be those which require the minimum of personnel.

With the above facts in mind, it is evident that effort should be made to bring into use every available natural enemy of the mosquito. They do not render the water unfit for use, their cost is low, and the work may be performed with aid of a minimum of personnel. Furthermore, many of the natural enemies are already present and many more can be introduced.

As has been mentioned, the guppy or rainbow minnow (*Lebistus reticulata*) has already been given a start and is at work against the mosquito. Our experiments have shown the effectiveness of this fish and the literature of all nations gives testimonials as to their great value.

The *Lebistus reticulata* prefer water of 75°-80° and the females under ordinary conditions will breed about every four to six weeks.

A young parent will bear as many as 10 to 20, while older ones may deliver as many as 50. They are cannibalistic and in absolutely clean pools many of the young are immediately destroyed. In the presence of floatage and grassy plants the young can dodge and hide from their predacious parents until they are big enough to protect themselves. The beautifully marked males acquire their color when 8 to 10 weeks old and at that time are ready to breed with the females of that age or older. The females are yellowish and larger and stouter than the males.

These fish should be adequately planted throughout the stream courses with particular attention to those areas within the more thickly inhabited areas of the island. Concentration should be made in those portions of the stream known to hold water throughout long droughts and in the vicinity of cattle corrals and fords. Fish transplants should be made into any natural water-holding area where it is estimated that there will be water for as long as three months. It is well to remember that the most active breeding on the part of the fish is acquired by planting a predominance of males, at least three to one.

Débris in the streams and uneven dirty banks tend to inhibit the effectiveness of the fish through the formation of protected areas to which the fish do not have access. The ideal, of course, would be to have these stream banks cleared and the débris and frondage removed but this would be an endless task in these tropical streams and one for which no money is at present available. This may be accomplished eventually but at present it is impossible. Means of reducing the breeding in such protected areas will be mentioned later.

Fish probably reach their greatest value in the impounded waters, because no other measure is as suitable in tanks, cisterns, and dams where rain water is stored for drinking, and when adequately stocked with fish, the mosquito breeding is well controlled.

Occasionally a property owner will object to having fish placed in his cistern and in substantiation of his objection will cite instances where the water has been spoiled by such a procedure. The cistern water can only become "fishy" in the presence of great numbers of fish. Being very predacious in a clean cistern, the fish keep their own numbers controlled by their cannibalism. In a cistern which is dirty with much "settling" and floatage, the fish derive a certain amount of food from the sediment, while the floatage and top growths afford an easy escape for the new born. Their multiplication will then cause the container to become overstocked. However, a cistern dirty enough to allow this condition to occur ought to have the water turned out and the cistern thoroughly cleaned. The fish happen to act as good barometers in these cases.

Fish should be planted in shallow dams and troughs for breeding purposes only. Different breeding areas should be chosen throughout the island so that the fish will not have to be hauled long distances for transplanting when needed, as many die during this process.

If there is a dam large enough and suitable for breeding the fish on an estate it should be stocked and small numbers supplied to the village or villages on the estate for use in rain barrels, tubs, and other small receptacles. Reserve dams, partially covered, are best suited for breeding purposes.

The department of sanitation now uses a small concrete pond just behind the office, which is kept well stocked at all times for the distribution of fish to towns. The cisterns in town are supplied from this pond. Another larger one is really needed.

Besides the fish, other natural enemies of the mosquito should be encouraged. An Australian algæ, *Nitella phanlotes*, should be tried on this island. This form of algæ grows submerged, is lime loving, easily transplanted, and reproduces freely. It is not harmful to fish nor mammals, including man.

E. W. I. Buhot, a scientist of Brisbane, states that the mosquito will not lay her eggs where this organism grows. This is believed to be due to an oily substance which the algæ secretes. In other words, it is a natural automatic oiling plant. Cornell University is at present experimenting with species of *Natella*. *Chara* has been shown to have mosquito-controlling properties. It also should be tried.

It is believed that the maximum efficiency of these two named forms of plant life against mosquitoes is only reached in limestone country but they should be tried in St. Croix especially in the streams of our northwestern section.

Bladderworts should be planted in these streams. There are several species of Brazilian reticularia which should thrive here, and their larvæ-destroying properties are well known. Salt-water bladderworts should be tried in the brackish ponds.

The water hyacinth gained some fame in southern United States. It was noted that wherever it thrived, mosquitoes became less in number. This plant itself is not larvæ destroying, but it harbors many enemies of the mosquito. *Lemna minor* has been claimed to offer obstruction to the depositing of eggs by the mosquito. The rootless duckweed (*Lemna arrhiza*) is also effective and it is believed that it could be grown here.

It may be mentioned that the last-named plant has been used very successfully in the Rhine. It is particularly adapted to pool formations exposed to direct sunlight.

The introduction and development of these forms of plant life in St. Croix might be worked out in cooperation with the officials of the experimental station. The writer feels sure that these officials would be greatly interested and would render valuable assistance and the heartiest cooperation.

While speaking of plants, certain forms of Derris might be grown here. The roots when crushed and thrown into the water give off a milky fluid, which in very small quantities and very highly diluted will kill mosquito larvæ. As this is also destructive to fish and other forms of animal life, its use would necessarily have to be confined to those places where fish were not also being used. Sewer traps, cesspools, privy pits and the like could be cared for in this manner much cheaper than by the use of oil. The Philippines are working with Derris (*Derris elliptica*) at present.

The water beetles should be encouraged in the natural water-holding areas. A study of the Dysticidæ and the Hydrophilidæ might reveal certain factors which would increase their breeding properties. No benefit, however, can be expected from these natural factors unless they are dealt with on a large scale and given serious attention.

The use of oil is necessary in some areas. Oil is expensive from the standpoint of time, money, and personnel. Our present allowance for oil does not permit us to use this measure where anything else can take its place. Therefore our present policy is to limit its use to small areas, holding water temporarily; that is, for periods of not longer than a month or two. Our schedule is to oil a given area every eight days.

It should be remembered that a light film of oil in an area will not harm fish. Should any question arise as to how long the area will remain wet, and fish are not contraindicated for any reason, it is often wise to use a combination of the oil, a few fish, and lengthen out the schedule.

If oil is not used in the proper manner it does more harm than good in that it gives a false sense of security. To be effective it must be spread thinly and evenly over the entire water-holding area. It must be made to permeate over and through floatage and be well distributed along the stream banks. The spreading can be helped by mixing the oil with sawdust. We have been using one part of crude oil to two parts of kerosene but this does not seem to thin the mixture as well as it should.

Our present method of applying oil is to soak a bush broom in oil and shake it vigorously over the pool. This is inefficient, wastes oil, and does not permit the maximum distribution. If the use of oil is to be continued it should be thinned and distributed by a pat-

ented portable sprayer. These are relatively inexpensive, greatly reduce the amount of oil needed, and allow a much more perfect distribution. I believe enough saving would result from the use of these spray machines to allow the more extensive use of oil and might even prove a saving when one considers the high cost of kerosene oil in St. Croix, which is needed in large proportions as a diluting and thinning agent for the cheaper crude oil.

Oilers should be most carefully checked. They should be thoroughly and repeatedly instructed as to the proper use of oil, and should be made to keep their apparatus clean and in perfect condition at all times.

It is not uncommon to see uninstructed or poorly supervised oiling squads blowing oil over bushes and trees, thus dissipating all the saving for which the blowing device was intended. They should be carefully and repeatedly instructed to the effect that their job has but one object in view, "To completely cover a given water-holding area with a thin, even coat of oil."

In Porto Rico, oil is no longer used in mosquito control. It has been supplanted by a mixture of Paris green with road dust (1 per cent) which is sprayed over the water-holding areas. It is much cheaper than oil and said to be just as effective. Earle, who is in charge of the work in Porto Rico, told the writer that in many places cattle had been known to drink water which had been dusted with the Paris-green mixture and he was certain that in one area people had drunk water so treated without harm having resulted.

Porto Rico buys the Paris green locally in San Juan at about 17 to 19 cents per pound in 100 to 300 pound barrels and their running cost averages 70 cents per kilometer of ditching.

Inspection of natural waters is not a "white-collar" job. It is impossible to dip here and there from a bank and get accurate findings. Particularly is this true in St. Croix, where the stream banks can not be easily traversed. It is necessary in most instances to enter and follow the stream bed itself if data of any value are to be obtained. Furthermore, while inspectors can be trained within a day or two to recognize larvæ, the presence of a better-informed individual is required to give the best results. Some member of the medical personnel must be constantly in the field or at least be there at frequent intervals. This increases the interest of the subordinates, lends dignity to an otherwise wet and unpleasant detail, emphasizes the importance of what might to an ordinary inspector be a boresome water-dipping procedure, and makes possible a more thorough training of the subordinates in the field.

The writer has also found that it is of great help to have the individual inspector bring in his own larvæ and pupæ and hatch them.

This lends a technical aspect to their work and allows them to identify themselves more prominently with a public undertaking.

The impounded waters (storage) must be regularly inspected. Not only is the amount and kind of breeding to be noted, but also the presence or absence of fish or other control measures. Proper screening of inlets, outlets, and vents of cisterns and tanks should be emphasized. Necessary repairs to and cleaning of their storage containers should be recommended to the owners as indicated. Every effort should be made to acquire and maintain the interest and cooperation of the estate dweller in his attention to these details. Experience here has shown that in most instances mosquitoes will be so noticeably reduced that the maintenance of his cooperation and support will not be difficult once he has been persuaded to comply with these measures. The small receptacle breeding should be the easiest to control, but in reality it is the hardest.

Rain barrels and tubs which are being used by the villagers can be stocked with fish or protected by a covered burlap or screening. Of these, the fish are best, but the villagers must be constantly warned not to destroy them or remove them by dipping.

These small containers are really essential and cannot be dispensed with. The ideal would be to institute the general use of a barrel, headed at both ends except for a small screened inlet in the top through which a spout can run, with an outlet from a low placed bung. The institution of such a barrel can only be brought about by the interested cooperation of those in authority on the estate where the village is located.

An interesting and practical finding should be noted here. About a village dwelling where numerous small water-holding receptacles are found, a few larvæ will be recovered from each. Where one large rain barrel, tub, or iron pot, serves as the water reservoir, a greater number of larvæ will be recovered. But careful observation will show that in the numerous small receptacles a maximum number of mosquitoes will result, while from the one large container apparently only a few of the larvæ reach maturity, due in all probability to lack of food. The larvæ become whitened, transparent and ghostlike while many of them die. This has been tried out several times, always with the same results. A larger number of mosquitoes matured in the numerous smaller receptacles, each containing a few larvæ, than were ever obtained from a single larger receptacle, containing many larvæ. We should thus encourage fewer and larger water containers, which apparently, without any control measure whatsoever being present, would tend to lessen the number of mosquitoes.

As to such breeding as may be found in cast off tins, bottles, and the like, nothing can be accomplished by insisting that such recepta-

cles should not be allowed to hold water. In a village which is overgrown with weeds and tall grass, with rubbish and refuse of all kinds everywhere, with no privies on the premises, and with dwellings in a dirty and disordered state, one can hardly expect to find inhabitants who can be depended upon to reduce the number of small water-holding receptacles scattered about. Until the villages in general are thoroughly cleaned, suitable latrines built and definite dumping ground for refuse designated, very little can be done against the small receptacle breeding.

The sanitary law of St. Croix renders the owner responsible for the cleanliness of his village. The law is explicit and covers the ground thoroughly, but it has not been complied with. This law only exacts what modern civilization recognizes as common decency, and asks only for the observation of those laws of hygiene which for ages have been recognized as essentials for a thriving, efficient, healthy, and happy people. A general village clean-up is most essential to the elimination of the domestic or urban breeder. An important feature in this phase of the work is the "selling" to the estate manager or overseer the importance of a clean village, to the end that the village may be kept clean in accordance with the standard of cleanliness as laid down by the health department and not in accordance with the long-existing native standard established by custom and accepted throughout the island.

Something might be said about screening. Taken as a whole, the island uses very little screening. None is to be found in the native villages. It is the experience of all property owners in St. Croix that screening is a most expensive item. The "sea blast" soon destroys the screening if it is of metal, while the gauze screening keeps out the breeze, catches dirt rapidly, and soon tears. Most of the metal screening which the writer has seen on the island is of too large a mesh to keep out the mosquitoes and serves its purpose only against flies, moths, and larger insects.

To be effective at all, the screening should be of wire and of No. 16 mesh. If No. 14 is used, it should be painted over to reduce the size of the mesh. In fitting screen doors it should always be remembered to have them hung so as to swing outward.

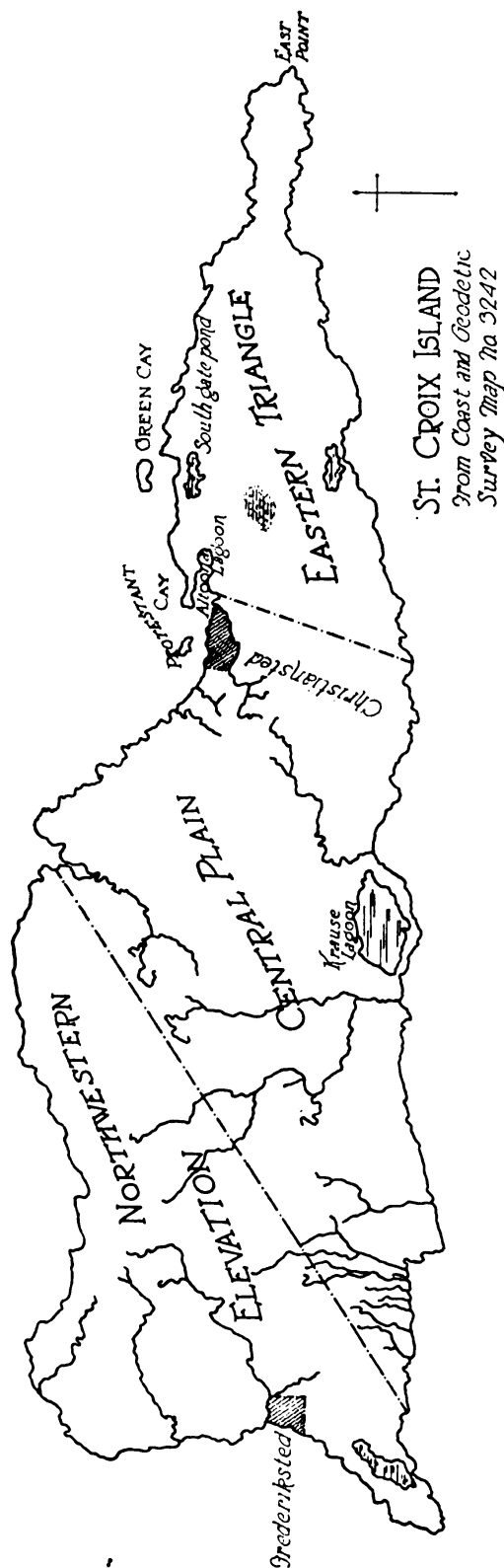
Earle has experimented with various types of screening in Porto Rico with regard to effectiveness against the mosquito, degree of resistance offered to the breeze, the effect of erosion, and natural wear and tear. Metal screening is, of course, preferable to cloth screening. The metals listed in order of choice (as determined by Earle's experiments) are: (1) Monel metal; (2) bronze or copper (0.015); (3) ordinary copper or bronze; (4) special galvanized (0.015).



In St. Croix, as in Porto Rico, screening is necessary all the year around. All reports seem to indicate that monel metal will outlast the copper and bronze for year-round wear near the ocean. Monel metal can be purchased as cheaply as the heavier copper and bronze. Those particularly interested in the details of the screening experiments and observations of the Porto Rican Malaria Control Bureau are referred to the Porto Rico Review of Public Health and Tropical Medicine of February, 1928.

In conclusion, it may be stated that the vital statistics, including morbidity statistics, collected and analyzed during the past year indicate that our present system of preventive medicine, as practiced in St. Croix, has not given the results desired or expected. After three years in St. Croix, the writer is convinced that the lack of a full-time medical officer who can devote his entire time to the problems concerning the public health as his major duty, is responsible for our mediocre results. This holds true not only for the mosquito-borne diseases but other conditions as well.

In submitting these findings and pertinent remarks, the writer is well aware that he has not made any novel contributions. It is felt that the



practical phases of the situation in St. Croix have been carefully surveyed and the recommendations have been made in accordance with the characteristics of this particular problem. By this orientation it is believed that a fresh start has been made for the control and prevention of the mosquito-borne diseases in St. Croix.

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**FURTHER EXPERIENCE WITH CEREBROSPINAL FEVER AT THE UNITED STATES NAVAL TRAINING STATION, NEWPORT, R. I.**

By F. G. ABEKEN, Commander, Medical Corps, United States Navy

Coincident with the increased prevalence of cerebrospinal fever in the United States, the disease has appeared, at intervals, during the year 1928 among the personnel attached to the United States naval training station, Newport, R. I.

The last previous case, and the only case which occurred in the year 1927, developed at this station on April 20. A small outbreak consisting of five cases occurred in January and February, 1928. Sporadic cases appeared on April 28 and August 9, and a second small outbreak of 3 cases developed in September. These cases were described in the United States Naval Medical Bulletin of January, 1929.

Sporadic cases then occurred on October 31 and November 10, 1928. The last outbreak of the year began on December 1. This outbreak consisted of five cases which developed on December 1, 2, 7, 16, and 18, respectively. Another patient from this station was admitted to the United States naval hospital, Philadelphia, Pa., with cerebrospinal fever on December 18. He was on authorized leave at the time. In 1929, one case of the disease appeared on each of the following days: January 13, 16, 18, and 28; February 5, 14, and 26; March 3 and 23, and May 23. In addition, two cases were admitted on March 5, making a total of 20 persons who contracted cerebrospinal fever presumably at the United States naval training station, Newport, R. I., during the time period October 1, 1928, to July 1, 1929.

Confirming the previous experience of the Navy that outbreaks of cerebrospinal fever may develop in the presence of epidemics of influenza and colds even when such predisposing influences are not very obvious, it is interesting to note that the incidence of catarrhal fever on this station began to exceed expectancy about December 1, 1928, and assumed epidemic proportions about Christmas time. After passing the peak about February 1, 1929, the number of admissions for this disease gradually declined until the average admission rate was approached about March 1. This period of time coincided with that of the general epidemic of influenza along the

east coast of the United States, and with the time when high morbidity rates from influenza were experienced in nearly all the civil communities of the country. The long-continued prevalence of catarrhal fever or influenza on the station may be explained in part, at least, by the continued arrival of recruits, many of whom were undoubtedly susceptible to the causative microorganisms, the frequent importation of the disease from the contiguous communities, and to unfavorable climatic conditions. Contact and dosage were thought to be important factors. In this connection it is of interest to note the results of Flexner's (1927) work with mouse typhoid. He found that when this disease starts sporadically in a mouse population, all that appears necessary in order to convert the occasional deaths with low cage-attack rate into frequent deaths with high cage-attack rate, is to bring into contiguous relation with the infected population increments of not previously exposed healthy mice.

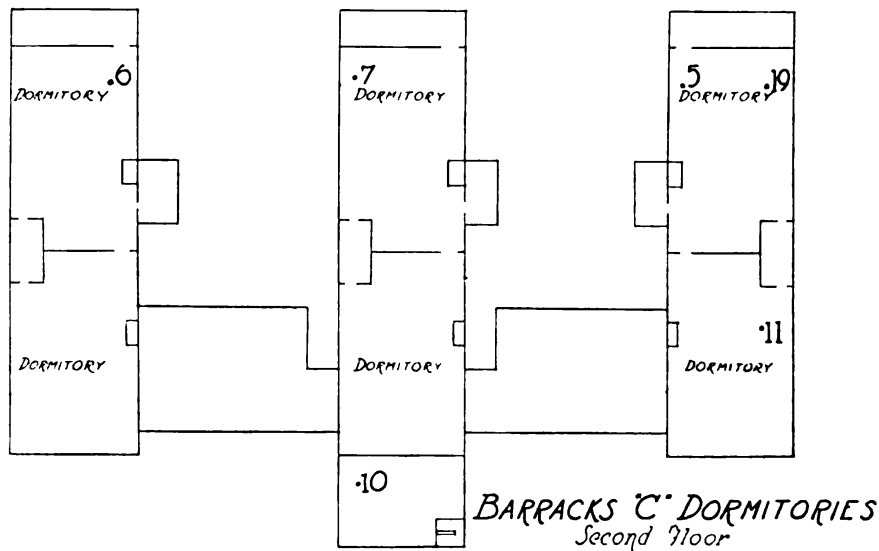
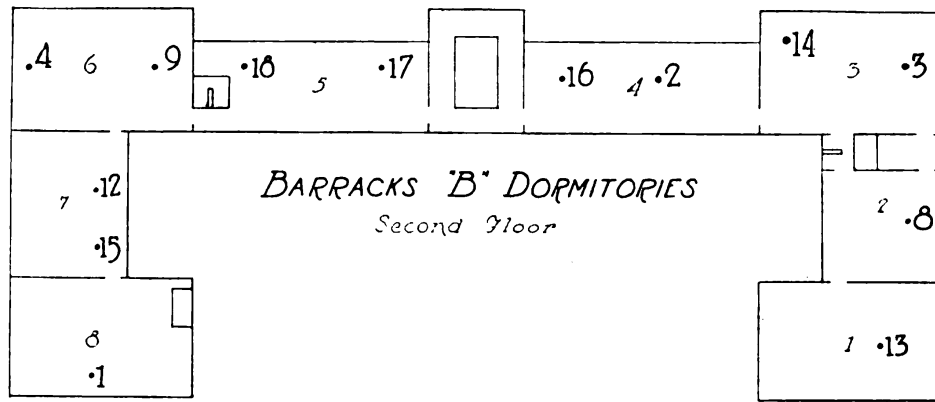
He further states:

The sporadic prevalence is quickly over. The new mice having been introduced, the succeeding events proceed in an orderly fashion. After an interval of about five days the latter, or new mice, begin to die, the number of deaths and the proportion of cages attacked rising day by day. During the first period in which the new mice fall victims to the disease the old mice do not show an increased death rate. But from the tenth to the twentieth day after the addition of the new mice, and hence the fifth to the fifteenth day following their deaths, the old mice are drawn into the wave of fatality, with the result that ultimately they suffer a mortality equal to or even greater than the new ones.

The epidemics thus inaugurated, as indicated by the deaths, usually diminish or even disappear before all, sometimes after only a small part of the exposed mice have been destroyed. A tendency shown by all the experiments is for a state of equilibrium between the surviving mice and the infecting bacillus to be effected, this state continuing until fresh infectible material is provided, when there arises undulations or epidemic waves of deaths remarkably uniform in respect to the successive replacements of fresh mice. The undulations cease gradually, the late fatalities resulting not from delayed infection so much as from protracted illness and long survival. Bacillus carriers arise in the course of the epidemics and show, through possession of agglutinins, the existence of a partially immune state. It is through these carriers that the disease is propagated, in spite of which, as the events prove, the partially immune individuals are not themselves adequately safeguarded, since, as we have seen, the older mice which have weathered one or more epidemic storms ultimately sicken and succumb. Here another factor operated, and this all-important one in overcoming natural and acquired resistance is the factor of quantity or dosage of the bacilli.

It is believed that the above quoted work of Flexner explains, in part at least, the continuation of the outbreak of catarrhal fever and cerebrospinal fever. Seasonal prevalence and climatic conditions have been given careful consideration. The influence of weather conditions as a predisposing cause of cerebrospinal fever became apparent early in the outbreak when it was noted that sporadic cases

always appeared within the first 48 hours after a cold rainstorm. From October, 1928, until late in the spring of 1929, storms accompanied by rain and wind which varied from a stiff breeze to a gale in force, have frequently visited this section of the coast. Nevertheless, statistical records at this station show that these cases occur



Cases indicated by heavy figures in order in which they occurred.

quite regularly throughout the year, summer as well as winter, with the greatest incidence in December and February.

All of those who contracted cerebrospinal fever were in different companies and in so far as could be determined had not been in direct contact with one another. The spot map of the occupied dormitories is self-explanatory. It shows the location of the billets of all those attacked. Barracks B and C are the quarters used in housing the recruits and are separated from each other by about 100 yards. With the possible exception of cases No. 17 and 18, which

were admitted the same day, there is no apparent relationship between any two cases from the standpoint of incubation period and date of onset.

The methods pertaining to meningococcus meningitis given in the report of the Committee on Standard Regulations for the Control of Communicable Diseases, published in the American Journal of Public Health, 1927, are as follows: Recognition of the disease, and isolation of infected persons until fourteen days have elapsed after the onset of the disease. Immunization is mentioned as in the experimental stage. Quarantine is not recommended but concurrent disinfection is advocated. The committee also suggests a search for carriers among those exposed to recognized cases, education as to personal cleanliness, and prevention of overcrowding. Under the caption "Epidemic Measures" appears the following:

"Increase the separation of individuals and the ventilation in living and sleeping quarters for such groups of people as are especially exposed to infection because of their occupation or some necessity of living conditions. Bodily fatigue and strain should be minimized for those especially exposed to infection.

"Carriers should be quarantined until the nasal and pharyngeal secretions are proved by bacteriological examination to be free from the infecting organism."

With the appearance of the first case October 31, 1928, a determined effort was made to institute every known method of prevention. These measures were enforced until about the middle of February when such procedures which seemed useless were omitted. The routine taking of nose and throat cultures in the search for carriers was discontinued at this time because of indifferent findings. It is still being made, however, when a case of the disease arises, but is confined to very close associates of the patient, such as occupants of adjacent berths or billets. The statement of Capt. O. J. Mink, Medical Corps, United States Navy, made as a result of his experience at the United States naval training station, Great Lakes, Ill., during the years 1917 and 1918, and which is quoted in "Epidemiology and Public Health," Vaughan (1922), is of interest in this connection. This statement is as follows:

It was possible during the epidemic to make cultures of practically every one of the 24 barracks connected with regiments. We found barracks in which meningitis developed that contained 8 or 9 per cent of carriers. On the other hand, we found barracks in which no meningitis developed that contained 25 or 30 per cent of carriers. In the instances in which a large percentage of carriers was found, carriers were removed; and in other instances the carriers were left in the barracks. New cases failed to develop in both instances. It was early found impracticable to remove all the carriers without producing overcrowding among the carriers, which resulted in additional cases.

There seems little doubt that the oft-repeated statement that carriers rarely develop the disease is erroneous, as the incident rate among carriers is higher than the rate for the general station. It is not the intention to maintain that carriers do not transmit the disease, but it is maintained that to combat this disease by the removal and segregation of all carriers is absolutely impracticable.

Routine daily spraying of the nose and throat with argyrol or equivalent solutions was stopped because of no appreciable results. The reduction of potential chronic carriers by the removal of enlarged tonsils and adenoids was also tried. This method of prevention was dismissed, however, as recent medical literature reported poor results from such procedures in that chronic carriers are often so by virtue of an infected sinus rather than from infected tonsils or adenoids.

Isolation or quarantine of exposed companies for 14 days was also discontinued for the reason that no case of cerebrospinal fever developed in those units which had been placed in quarantine. These factors were eliminated by the middle of February as unnecessary safeguards. As a result, there was, at least, no increase in the incidence of the disease thereafter, in fact by March 23, 1929, this outbreak had practically subsided. It should be stated that equable moderate weather did not prevail until June 1.

A copy of instructions for the prevention of cerebrospinal fever was used to familiarize or educate the officers and chief petty officers, because, in this particular disease, many of the factors are really under their control or supervision. It was found that the most tactful way to secure useful cooperation was through educational methods by means of official memoranda and by talks at the weekly officers' conferences. We thus instructed all, from the commanding officer down to the junior chief petty officer, in methods of prevention. To educate or control the individual recruit as to personal cleanliness of habits, a medical officer held weekly conferences with the chief petty officers in command of the various companies, as they are the only ones in constant contact with the men. The following instructions were submitted to the commanding officer for enforcement by the various officers:

#### PREVENTION OF SPINAL MENINGITIS

1. The following preventive measures for cerebrospinal fever or meningitis are recited to educate or acquaint the organization of this training station with modern methods to control the occurrence of this disease and to cope with an ever-pending problem at training stations in the more northern latitudes:

2. *Source of infection.*—Discharges from the nose and mouth of infected persons. Healthy persons who have never had the disease but have been in contact with cases of the disease or other carriers act as carriers and may spread the disease to a less immune person.

**3. Mode of transmission.**—By direct contact with infected persons and carriers and indirectly by contact with articles freshly soiled with nasal and mouth discharges of such persons.

**4. General measures for control.**—(a) Adequate ventilation must be insured. This requires hourly nightly inspection of dormitories, to take hourly temperature. A report should be submitted not later than 10 a. m. to senior medical officer. The inspector should see that the windows and skylights on the leeward sides are open. To meet the gradual seasonal changes of weather it is optional with the recruit to wear heavy or light underwear, as some recruits are accustomed to sudden weather changes and others are very susceptible to chilliness.

(b) Safeguard against overcrowding by increasing the separation of individuals in sleeping quarters for such groups of people as are especially exposed to infection. Under this condition 72 square feet per man of floor space should be allowed.

(c) Avoid exposure to chilling, overheating, and wetness. The senior drill officer will prescribe the uniform of the day that shall insure against these factors and inform the senior medical officer daily of such orders. Sentries should direct and report all men out of uniform of the day to the duty officer of the day. Warm bathing facilities should be provided for their early morning bath.

(d) Bodily fatigue or strain from drills or work should be minimized for those especially exposed to the infection.

(e) Men are forbidden to swap cigarette butts, spit on floors, sneeze or cough into each other's faces.

(f) Company commanders or chief petty officers of companies should educate the men as to the importance of personal cleanliness and hygiene and also with a view of correcting habits of carelessness. The chief petty officers of companies will confer every Monday morning at 10 a. m. with the medical officer.

**5.** A Hospital Corps man will report to the medical officer of the day the temperature of each dish sterilizer after each meal.

An abstract of the subjective and objective symptoms, with treatment and results, follows:

**Case 1:** Admitted October 31, 1928, complaining of intense headache, sore throat; W. B. C. 20,600, spinal fluid cloudy under pressure and many diplococci present. Given 240 cubic centimeters antimeningococcic serum intraspinally. Developed deafness bilateral. Invalided from service February 20, 1929, for that reason. Weather very damp and cold during the two weeks preceding admission.

**Case 2:** Admitted November 10, 1928, complaining of sore throat, vomiting, and intense headache; W. B. C. 18,000, neutrophils 90 per cent, lymphocytes 10 per cent, spinal fluid cloudy and under pressure many diplococci. During course of treatment was given 390 cubic centimeters antimeningococcic serum. Developed unilateral deafness. Invalided from service June 1, 1929 for this cause.

**Case 3:** Admitted December 1, 1928, with headache, sore throat, vomiting, petechial rash. W. B. C. 21,500, neutrophils 93 per cent, lymphocytes 7 per cent, spinal fluid cloudy and under pressure contained meningococci and many pus cells. Continued progressively worse and patient died December 13. He was given 390 cubic centimeters antimeningococcic serum intraspinally and intravenously during course of illness. Patient had felt poorly several days

seeking a "dryer" room for warmth. The weather had been very cold and damp for two weeks preceding his reporting to the sick bay.

**Case 4:** Admitted December 2, 1928. Complaint, headache, sore throat, stiff neck. Had been exposed to very inclement weather on duty inspecting sentries. W. B. C. 19,000, neutrophiles 87 per cent, spinal fluid milky under pressure; 365 cubic centimeters antimeningococccic serum used; uneventful recovery. To duty May 3, 1929, well.

**Case 5:** Admitted December 7, 1928. Complaint, headache, vomiting, sore throat, and soreness of back. W. B. C. 19,900, neutrophiles 87 per cent, lymphocytes 13 per cent, spinal fluid milky under pressure and contained diplococci; cell count 671; 190 cubic centimeters antimeningococccic serum used during course of disease; uneventful recovery. Duty April 16, 1929.

**Case 6:** Admitted December 18, 1928. Convulsions, crying, vomiting. Difficult to obtain coherent answers. Had been wet through by rain a few days previously and felt tired and "worn out" that night. Onset abrupt. W. B. C. 16,100, neutrophiles 90 per cent, lymphocytes 10 per cent, spinal fluid cloudy, pressure; intracellular diplococci identified as meningococci were found; uneventful recovery; 210 cubic centimeters antimeningococccic serum used intraspinally and intravenously. Duty May 3, 1929.

**Case 7:** Circumstances unknown. Admitted to United States naval hospital, Philadelphia, Pa., while on leave. He had been in a company, isolated because of another case of cerebrospinal fever, and had worked very hard previous to going on leave. The patient had driven a car from Newport, R. I., to New Jersey on a cold, windy day preceding his admission to hospital December 18, 1928.

**Case 8:** Admitted December 26, 1928. Complaint, headache, vomiting, stiff back and neck. Hard drinker, returning to station several times under the influence of liquor. W. B. C., 20,000; neutrophiles, 91 per cent; lymphocytes, 9 per cent; spinal fluid on first examination clear; cell count, 7. Twelve hours later cloudy, under pressure, and positive for meningococci. He was given 82 cubic centimeters antimeningococccic serum. Uneventful recovery. Duty March 17, 1929.

**Case 9:** Admitted January 13, 1929. Complaint, pains in wrist, knees, and ankles. Slight rise in temperature. Treated for rheumatism, acute, until January 25, 1929, when diagnosis was established as cerebrospinal fever. Spinal fluid clear, no organisms; cell count, 27; 60 cubic centimeters antimeningococccic serum intraspinally. Recovery uneventful.

**Case 10:** Admitted January 16, 1929. Symptoms, nausea, vomiting, petechial rash, injected pharynx. W. B. C., 18,300; neutrophiles, 89 per cent; lymphocytes, 11 per cent; spinal fluid cloudy, under pressure, and positive for meningococci. One hundred and ten cubic centimeters antimeningococccic serum used. Grew progressively worse; died January 19, 1929. This patient had been housed in a small barracks building with 19 other men. There was very excellent lighting and particularly an adequate amount of air space per man. As a member of the bugle squad his duties were lighter than average recruit under training. Weather conditions were wet and cold.

**Case 11:** Admitted January 18, 1929. Symptoms, headache, sore throat, stiff back muscles, petechial rash on body. W. B. C., 21,000; polymorphonuclears, 89 per cent; lymphocytes, 11 per cent. Case progressed to uneventful recovery March 19, 1929. Spinal fluid milky, under pressure, but no organisms were found in smear or in cultures, although the fluid was typical of meningitis. One hundred and ninety cubic centimeters antimeningococccic serum were used.

**Case 12:** Admitted January 28, 1929, with symptoms of bronchitis, acute. W. B. C., 18,200; neutrophiles, 84 per cent. On February 2, 1929, nausea, vomiting,



and general condition aggravated. W. B. C., 28,400; neutrophiles, 97 per cent; spinal fluid cloudy, pressure increased, and meningococci present. February 11, double pneumonia diagnosed. Despite this complication recovery was complete. To duty June 28, 1929. He received 150 cubic centimeters antimeningococccic serum.

Case 13: Admitted February 5, 1929 with cough, sore throat, and moderate headache. On the 6th of February, 1929, patient developed typical petechial rash on chest and abdomen. W. B. C., 18,500; neutrophiles, 90 per cent; spinal fluid cloudy, under pressure, but no organisms were found by culture or slide. About 200 cubic centimeters antimeningococccic serum administered during progress of disease. Uneventful recovery.

Case 14: Admitted February 14, 1929. Headache, vomiting, malaise. W. B. C., 18,200; neutrophiles, 82 per cent; The first spinal puncture was negative, but the clinical symptoms remained typical. Several days after admission spinal fluid became cloudy and pressure increased. No organisms. One hundred and twenty cubic centimeters antimeningococccic serum intraspinally and intravenously during course of disease. Recovery uneventful. Restored to duty June 7, 1929.

Case 15: Admitted February 26, 1929. Cough, sore throat, moderate headache. No severe symptoms until February 28, 1929, when headache became extremely marked; patient was restless and reflexes were exaggerated. W. B. C., 18,400; neutrophiles, 92 per cent; spinal fluid typical of cerebrospinal fever. About 140 cubic centimeters antimeningococccic serum administered during course of disease. Recovery without complications.

Case 16: Admitted March 3, 1929. Headache, vomiting, malaise. Reflexes exaggerated. W. B. C., 10,000; neutrophiles, 76 per cent. Spinal fluid clear; cell count, 10. Ninety cubic centimeters antimeningococccic serum intraspinally, 60 cubic centimeters intravenously. From clinical symptoms considered cerebrospinal fever. Recovery uneventful. Duty May 31, 1929. Weather conditions were cold and wet.

Case 17: Admitted March 5, 1929. Headache, vomiting, malaise, reflexes exaggerated. W. B. C., 20,000; neutrophiles, 88 per cent; lymphocytes, 12 per cent. Spinal fluid clear; cell count, 5, later 2,100 after serum administration. No organisms. Thirty cubic centimeters serum intraspinally, 30 cubic centimeters intravenously. Developed bilateral deafness. Invalided from service June 1, 1929.

Case 18: Admitted March 5, 1929. Complaint, sore throat, tonsils enlarged, cryptic and spotted with exudate. W. B. C. on March 6, 1929, 25,000; neutrophiles, 81 per cent; lymphocytes, 19 per cent. Headache, spinal fluid typical, reflexes exaggerated. Recovery uneventful. He received 135 cubic centimeters antimeningococccic serum.

Case 19: Admitted March 23, 1929. Headache, sore throat, extreme lassitude. Kernig's sign markedly positive, reflexes very markedly exaggerated. W. B. C., 19,000; neutrophiles, 89 per cent. Spinal fluid cloudy, under pressure, and many meningococcus present. In spite of intensive treatment this patient required two laminectomies for drainage of spinal canal. Case is still under treatment with some improvement of mental faculties, but great impairment of general physical condition.

Case 20: Admitted May 23, 1929. Comatose, able to walk, but could not be aroused to answer questions, had vomited. W. B. C., 40,000; neutrophiles, 95 per cent. All signs positive. Spinal fluid milky, under pressure, and many organisms present. Case appeared hopeless from admission. Died May 25, 1929. One hundred and five cubic centimeters antimeningococccic serum intraspinally and intravenously administered.

All patients but one were treated at the United States naval hospital, Newport, R. I.

It may be stated that properly supervised sterilization of mess gear and cleanliness in the mess halls by daily washing with lysol solution are regularly practiced at this station. The equipment installed for the washing and sterilization of mess gear consists of two types. In one, barracks (B), the dish-washing machines are of the Champion type, are electrically operated, and are equipped with pumps for spraying hot wash water upon the dishes. The machines also have strainer screens for the collection of food particles. In the other, barracks (C), the dish-washing machines are of the "Niagara" type and are electrically operated with automatic control. They are equipped with an open type of water impellers for washing, and with two sets of rotating sprays for rinsing, one set above the dishes and one below. This type machine is also equipped with a strainer to keep the food particles from the wash water. The strainer is easily removed from the machine for cleaning purposes. There are no high-speed pumps or complicated parts connected with the latter machine. It is a very compact piece of equipment and takes up a minimum of space.

These dish-washing machines are operated by feeding the dishes through the machines in racks, especially built for the purpose. After going through the machines, the dishes, while still in the racks, are immersed by means of an overhead control into a sterilizer. The sterilizer is nothing more or less than a deep galvanized iron box, in which the water is heated by steam and maintained at the boiling point during sterilization. These sterilizers are of a home-made type. The sterilizing tanks are arranged so as to give the dishes at least a full minute exposure to boiling water and are of sufficient capacity to maintain a temperature of at least 212° F.

The efficiency of washing and sterilizing mess gear is best measured by the morbidity rate for mumps, measles, chicken pox, and scarlet fever, which is practically nil at this station.

#### SUMMARY

(a) No quarantine instituted; (b) no antiseptic spraying of nose and throat; (c) no culturing of throat for detecting carriers; (d) no removal of tonsils or adenoids, unless for mouth breathing or metastatic infections; (e) personal supervision of carefully issued educational instructions to safeguard against exposure to chilling, overheating, wet clothing, fatigue from excessive drilling, and hourly inspection of ventilation; (f) floor space of 50 square feet per man, 72 square feet or more desired; (g) early diagnosis; (h) corrections of individual carelessness through educational methods.

## CONCLUSION

The most reliable methods of prevention against the disease under discussion are open air, sunshine, and maximum amount of floor space per man. In fact, a floor space of 72 square feet per man is considered to be the minimum requirement, when preventive measures for any communicable disease are necessary. In an equable climate the contingency of maximum floor space can be coped with, but at a training station north of 40° latitude the problem is more difficult.

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**IMPORTANT FACTORS IN THE EARLY RECOGNITION OF CEREBROSPINAL FEVER**

By P. F. DICKENS, Lieutenant, Medical Corps, United States Navy

At present our views are that infection in cerebrospinal fever takes place through direct contagion or contact. Medical officers of the service should bear in mind that the disease is primarily a blood stream infection and that it may or may not invade the central nervous system. The infection may remain confined to the blood stream or may metastasize to the heart, joints, or pleura. However, the majority of cases will show involvement of the meninges earlier or later in the course of the disease.

The period of infection may be divided into three stages, namely, the infective, blood stream invasion, and meningeal.

*The first or infective stage.*—The patient may exhibit symptoms of an acute coryza. During this period the microorganism may be recovered from the secretions of the nose and throat. The diagnosis of the first or carrier stage is usually missed. Should meningococci, however, be recovered from the upper air passages, the use of strong antiseptic solutions is not advised. General measures such as fresh air, sunshine, and liberal diet to aid in building up the resistance of the patient are preferable. Separation of individuals by increasing the amount of floor or deck space per person is believed to be of the utmost importance in the military service. Fatigue, especially in inclement weather, is a definite factor in precipitating an attack of cerebrospinal fever in the recruit. This factor is of particular importance during the carrier stage.

*The second stage, or blood stream infection.*—During this stage the microorganism is present in the blood stream and symptoms of general sepsis are evident. The patient is dull, apathetic, desires to be left alone, and resents interference. A change in the mental reaction is one of the earliest and most striking symptoms. A rise of body temperature is generally observed, Cecil, on page 115 of his *Practice of Medicine*, states that the average temperature in 300 cases was

101° F. Pains in or about the joints are of frequent occurrence, but the rash, of course, is the most characteristic, though not constant, feature and should always be searched for. The rash is a maculopapular eruption which generally appears first on the trunk, forearms, and legs. It is a typical capillary hemorrhage into the skin, does not ordinarily disappear upon pressure, and individual lesions may vary in size from pin head to as large as half an inch in diameter. Patient may complain of being "sore all over" or again of pain in the skin especially if the skin is placed under tension.

The white blood cell count is extremely significant in the early stages of this disease. It almost invariably shows an increase, and may vary from 15,000 to 30,000 or more cells per cubic millimeter. This, together with a differential count of from 80 to 90 per cent of polymorphonuclear leukocytes, constitutes a significant finding in a febrile apathetic patient in whom a physical examination reveals nothing except a temperature of about 101° F. to account for his condition. Therefore, such findings should place one on guard and indicate the possibility or probability that the case is one of cerebrospinal meningitis. The most important single finding in a patient complaining of a headache, however, is the high polymorphonuclear leukocyte count, averaging 85 per cent.

In this stage meningeal symptoms are absent, the cerebrospinal fluid is normal, clear, and has a normal cell count, but the globulin content may be increased. During this stage spinal fluid cultures are usually negative and this condition of the cerebrospinal fluid may last for days or throughout the course of the disease. Blood cultures are of prime importance. From 5 to 10 cubic centimeters of blood should be withdrawn for making blood cultures. The stage of sepsis or blood stream invasion may endure for only a few hours, but generally lasts for from about five to seven days. Winthout emphasizes the fact that after the first case of cerebrospinal fever has appeared the medical officer should be constantly on the alert to detect patients in the premeningitis stage, as it is in this stage that the intravenous use of antimeningococcus serum may be of life-saving importance.

*The third or metastatic stage.*—Beware of any condition in which the patient exhibits stiffness of the neck, especially in the presence of a headache, chilly sensations to actual chill, vomiting, fever, or any combination of the above symptoms. The pupils are usually dilated during the early period of this stage, herpes labialis is commonly present, and the leukocytosis of the second stage continues. The respiration may be of the Cheyne-Stokes or the Biot type, the latter being a significant sign. With metastases to the meninges, the Kernig and Brudzinski signs will become positive and the patient will usually exhibit some stiffness of the neck.

The pressure of the cerebrospinal fluid begins to rise, the globulin content increases, and sugar begins to diminish. A cell count will reveal an increase and the causative microorganism may be identified in stained smears or in cultures made from the cerebrospinal fluid. Blood cultures made during this stage usually give a growth of meningococci, but these findings are more often encountered in the second stage.

A safe clinical rule is to proceed at once with antimeningococcus serum therapy whenever a febrile patient has cloudy cerebrospinal fluid whether it is under pressure or not and even when no meningococci can be demonstrated by smear or culture. The serum should be administered both intravenously and intraspinally. Whenever the cerebrospinal canal is punctured as a diagnostic measure in suspected cases of cerebrospinal fever, regardless of findings, serum should be given before the needle is withdrawn.

The following laboratory procedures should be performed in the case of every patient suspected of having cerebrospinal fever: (1) Daily blood cultures during the first few days of the disease, especially if the cerebrospinal fluid is negative; (2) leukocyte count every day; (3) culture the cerebrospinal fluid and examine smears in addition to making cell counts, globulin and sugar estimation; (4) test the potency of available sera by the agglutination method with microorganisms obtained from the first positive culture regardless of whether it was made from the blood or the cerebrospinal fluid.

A serum which fails to agglutinate in a dilution of 1 to 50 is rarely efficacious. While this may be ideal in testing the potency of sera, the use of any serum which proves itself efficacious by giving clinical results in a severe case should be continued. He is a good clinician who does not allow the laboratory to stampede him into making a diagnosis or in using a certain therapeutic agent. Therefore, if any given serum is not producing definite results, sera of other manufacture should be tried. Shifting from one serum to another may be a life-saving procedure.

*Treatment.*—Initial infection of the nasopharynx is rarely diagnosed and antiseptics locally applied are probably contraindicated for the reason that breaks in the mucous membranes are ideal surfaces for invasion.

*Stage of sepsis (blood stream infection).*—The chief method of attack here is by vigorous intravenous injections of serum. One hundred cubic centimeters should be thus given every 6, 8, or 12 hours in accordance with the clinical symptoms presented. The dose and treatment should be dependent upon the results obtained. In all positive cases daily spinal punctures should be performed and

the spinal canal drained. When cerebrospinal fluid is withdrawn, 20 to 30 cubic centimeters of serum should be introduced. Give 5 to 10 cubic centimeters less serum than spinal fluid removed. Examine all spinal fluid for evidence of invasion by the meningococci; i. e., smear, culture, cell count, etc. These procedures serve as a check on the cerebrospinal fluid while the giving of serum helps to prevent metastasis if the spinal fluid should be negative. The latter therapeutic measure should be performed especially in those cases in which blood cultures have been positive. The combined intrathecal and intravenous medication should be continued daily until the temperature, pulse, and respiration return to normal, organisms disappear from the cerebrospinal fluid, the mononuclear cells in the cerebrospinal fluid return to normal limits, and blood cultures are negative.

*Follow-up treatment.*—The cerebrospinal fluid should be withdrawn every other day for at least three withdrawals to prevent cerebrospinal bloc and to serve as a check on pressure, cell count, and possible return of microorganisms, as determined by smear and culture.

#### CONCLUSION

The main points to remember in cerebrospinal fever are as follows:

1. Primarily a blood stream infection. Blood cultures indicated in the first week and intravenous medication with antimeningococcus serum necessary throughout the disease.
2. Metastasis to the meninges occurs in the average case. The cerebrospinal fluid generally is under increased pressure, cultures are generally positive, and globulin increased. The cell count is greatly increased and the cells found are generally polymorphonuclears.
3. With microorganisms recovered in the first culture, test sera by agglutination. Use the serum, both intravenously and intrathecally, which has the highest titre.
4. After the first negative smear and culture have been obtained from spinal fluid, and temperature, pulse, respiration, and cell count of the cerebrospinal fluid have returned to normal, daily treatment with serum may be stopped.
5. It is advisable to drain and examine the spinal fluid three times to check against any reinvasion of the cerebrospinal fluid and to prevent bloc.
6. Serum sickness should not prevent continued medication in positive cases.
7. Carefully watch for the usual complications which may be expected in blood stream infections.

Doctor McCoy, of the United States Public Health Service and director of the Hygienic Laboratory, Washington, D. C., has permitted the writer to quote him as follows:

While death may occur after the first injection of a given serum, it almost never occurs following the second and subsequent injections. We may expect serum sickness on second or subsequent injections; however, this reaction never produces death. Serum sickness may occur following first injections.

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**A FULMINATING CASE OF CEREBROSPINAL FEVER AMONG EXPEDITIONARY FORCES, SHANGHAI, CHINA**

This case was reported by Lieut. Commander Henry C. Weber, Medical Corps, United States Navy. The patient, a corporal of the Marine Corps, 27 years and 5 months of age, was first seen about 8.50 a. m., April 15, 1929. He had a slight headache and showed symptoms of lethargy but was still able to answer questions. He had not vomited and no rigidity of the neck was apparent, but the knee reflexes were exaggerated, Kernig's sign was positive, and he presented a rash typical of cerebrospinal fever. He was immediately transferred to the hospital of the Fourth Regiment, United States Marines, Shanghai, China. Upon being moved he vomited for the first time, had an involuntary bowel movement, and became unconscious soon after he reached the hospital. A blood examination showed 22,500 white blood cells with 96 per cent polymorphonuclear leukocytes. The cerebrospinal fluid was slightly turbid and under increased pressure; therefore 30 cubic centimeters of antimeningococcus serum were immediately injected before the needle was removed. Spinal puncture was repeated ten hours later. At this time the pressure was very much increased and flakes were noticed in the fluid. Thirty cubic centimeters of the serum were again injected intraspinally. Although the general appearance of the patient improved somewhat during the day, he had several involuntary bowel evacuations and had to be catheterized as he was unable to void his urine. Cultures from the blood revealed a pure growth of meningococci and stained smears made from the cerebrospinal fluid indicated a massive infection by the meningococcus. Death occurred at 5.25 a. m. the following morning, or less than 24 hours after he came under medical observation.

The commander in chief, Asiatic Fleet, in a report dated May 29, 1929, stated that cerebrospinal fever has been epidemic among both the Chinese and foreign population groups of Shanghai over a period of five months. The total Chinese population of the International Settlement is estimated as 828,420 and the foreign population as 32,795. There was a total of 487 reported cases with 295 deaths

among the resident and nonresident Chinese. Of the 76 reported cases and 36 deaths which occurred among foreigners, Japanese residents furnished the greatest number.

The origin of the epidemic is, on reasonable grounds, supposed to have been in the Province of Chekiang. The epidemic began to spread along the estuary of the Chientang River and along Hangchow Bay in April, 1928. At this time the commissioner of public health in Shanghai received word of a "mysterious infectious disease" which commenced with symptoms resembling malaria and influenza and which frequently caused death within a few days.

The disease continued to spread throughout the summer and by October it was estimated that there had been about 3,000 cases with 1,000 deaths. The spread occurred gradually along all of the usually traveled routes, so that by April, 1929, cases began to be reported in Nanking and Hangchow. With the advent of warm weather in the latter part of May there was a decided drop in the number of cases reported. In addition to the case described above it was stated that the child of an officer contracted the disease and died.

This report also stated that, had there been an epidemic of the disease among the United States forces, it was planned to take over the regimental hospital of the Fourth Regiment, United States Marine Corps, in Shanghai and operate it as an isolation unit for all forces, as the local isolation hospital was functioning to capacity with civilian cases.

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#### A CASE OF CAISSON DISEASE RESULTING FROM INSUFFICIENT DECOMPRESSION

The following account is based on a report submitted by Lieut. Commander Charles L. Beeching, Medical Corps, United States Navy, the senior medical officer of the U. S. S. *Argonne*. A quartermaster, first class, attached to the U. S. S. *Argonne*, who was also a diver, second class, was seized with caisson disease, or the bends, about 2 hours and 21 minutes after he had completed a dive. On June 6, 1929, a submarine laid eight mines in about 100 feet of water near San Diego, Calif. In order to recover two of these mines, diving became necessary.

The diving boat, in charge of an experienced and qualified diver and carrying a medical officer, one first-class and four second-class divers, proceeded on the morning of June 7 to the area in which the mines had been planted. As the first-class diver had terminated a dive made to a depth of 123 feet at noon of the preceding day, and as two dives were to be made, it was decided to use others for the first dive so that he would be available in case of accident.



The quartermaster, first class, who had considerable experience in diving and who had descended at three different times to depths in excess of 100 feet with the same equipment which was to be used, was accorded permission, at his own request, to make the first dive.

Encased in a regulation unit, the diver started descending at 5.54 a. m., and reached the bottom at a depth of 103 feet of water at about 6 a. m. He reported, 52 minutes later, that he had torn one of the cuffs, that the suit was filling with water, and asked to be brought up. He was immediately raised to the 30-foot stage, where it was determined by signals that the leakage was not serious. About two minutes later he gave the emergency and telephone signals to be hauled up and was immediately brought to the surface where inspection showed that the interior of his helmet was dry and that the leakage was not endangering him. He was, therefore, returned to the 30-foot stage where he remained for 10 minutes, at the expiration of which he was brought to the 20-foot stage and decompressed for a period of 15 minutes, then brought to the 10-foot stage for 20 minutes, and finally returned to the surface at 7.39 a. m.

Upon removal of his suit it was found that his right arm was wet, as was his entire body up to the waist. Accompanied by the medical officer in attendance, he was immediately taken aboard and into the engine room of the U. S. S. *Partridge*, which was anchored about 100 yards away. Here his clothing was removed and he was given a thorough rub down. He was given some hot black coffee and a change of dry clothing. An examination made at this time showed that he was apparently normal and in good physical condition. He remained aboard this vessel for about one and one-half hours, during which time he engaged in various activities, took a number of pictures with his kodak, seemed to be in good spirits, and stated that he was feeling fine. About 9.40 a. m. he returned and joined the crew aboard the diving boat. Twenty minutes later, or about 2 hours and 21 minutes after completing his dive, while helping to dress another in a diving suit, he was suddenly seized with dizziness, nausea, and a violent attack of vomiting. Within a few minutes he complained of a severe pain in his right elbow and a sensation of numbness in his entire right side. He was immediately returned to the U. S. S. *Partridge*, placed in a bunk, wrapped in blankets, surrounded by hot-water bottles, and given a teaspoonful of aromatic spirits of ammonia in half a glass of water. His arms and legs were massaged as freely as his condition would permit, but as the extremities had become very painful he objected greatly to this procedure.

A radio message was sent to the commander, Submarine Division 20, on board the U. S. S. *Argonne* about 6 miles distant, requesting that the U. S. S. *Ortolan*, the only ship present which was equipped

with a recompression chamber, be dispatched to the scene of the accident. At the time the message was received, this vessel was standing out of the harbor en route to Mare Island, Calif., but was intercepted by signal and ordered to proceed to the vicinity of the diving operations to recompress a diver with the bends. As soon as word was received that the U. S. S. *Ortolan* was coming, the anchor was raised and the U. S. S. *Partridge* proceeded in order to meet her.

The patient's symptoms in the meantime continued to increase in severity. He began to have abdominal cramps coming in definite paroxysms, which were so severe that the patient was doubled up, shrieking and grinding his teeth because of the pain. These attacks lasted from three to four minutes and terminated with violent vomiting. He also complained of intense pain in the region posterior to the right mastoid process. At this time a slight skin eruption was noticed in the form of a few irregular macular patches over the lower part of the abdomen. Respiration was normal and the pulse was strong though the rate was increased.

Following the arrival of the U. S. S. *Ortolan* at 11.20 a. m. the patient was taken aboard and immediately placed in the recompression chamber. The pressure was increased as rapidly as circumstances would permit, and, at 30 pounds per square inch, the symptoms were greatly relieved, but he still complained of pains in the abdomen. At 40 pounds per square inch, however, all symptoms disappeared. The pressure was maintained at this point for 10 minutes, then decreased to 30 pounds, and decompression continued according to the following table.

Pounds pressure	Minutes	Time
30	12	11.48 a. m.
25	18	12.06 p. m.
15	20	12.26 p. m.
10	25	12.51 p. m.
5	30	1.21 p. m.

Oxygen was administered at intervals while the first stage of decompression was being accomplished and hot towels were applied to his abdomen. He vomited several times, but the pulse and respiration were within normal limits. When decompression was completed at 1.21 p. m. he stated that he felt weak and that he experienced some dizziness upon moving his head to either side, but that all of the pains had disappeared.

He remained in the recompression chamber but under no pressure for a period of about five hours. During this time he complained of severe photophobia, dizziness whenever he changed his position, and

nausea. These symptoms gradually became more pronounced, and, after about four and one-half hours, he stated that his left eye felt as though it were being pulled downward and to the right. An examination, however, failed to show the presence of nystagmus or other ocular signs. Finally severe pains developed in the right wrist and elbow about 6 p. m.

Pressure was again applied, and, while 15 pounds relieved the patient of the above symptoms, it was nevertheless increased to 25 pounds where it was held for 20 minutes. He was then decompressed in accordance with the following table:

Pressure in pounds	Rate of decompression	Time
20	1 pound in 5 minutes to 15 pounds.....	25 minutes.
15	1 pound in 10 minutes to 10 pounds.....	50 minutes.
10	1 pound in 10 minutes to 5 pounds.....	Do.
5	1 pound in 15 minutes to 0 pounds.....	75 minutes.

When 5 pounds was reached the patient became ill, so the pressure was increased to 15 pounds at 8.25 p. m. and was allowed to drop at the rate of 1 pound each 10 minutes. After the above decompression was completed the patient rested very well, slept about five hours, and upon awakening stated that he was feeling fine. He took some nourishment, which consisted mostly of milk.

About 9.20 of the morning following the onset of symptoms he again complained of severe pain, this time in the right ankle joint. Recompression was started and by 10 a. m. the pressure had been built up to 60 pounds per square inch, which relieved him of all symptoms. After five minutes it was dropped rapidly to 30 pounds and decompression continued as indicated in the following table:

Pressure in pounds	Rate of decompression	Time
30	1 pound in 5 minutes to 15 pounds.....	75 minutes.
15	1 pound in 15 minutes to 5 pounds.....	150 minutes.
5	1 pound in 20 minutes to 0 pounds.....	100 minutes.

When decompression was completed the patient left the chamber with assistance and was placed on a cot in the fresh air alongside the recompression chamber. His condition at this time was very good. As the U. S. S. *Ortolan* was scheduled to sail for the navy yard, Mare Island, Calif., the patient was transferred to the U. S. S. *Holland*, as this vessel is equipped with a recompression chamber. It was considered inadvisable to have him too remote from such a device in case it became necessary to place him again under pressure.

The first night on board the U. S. S. *Holland* the patient rested very comfortably and stated that he did not have the unpleasant

dreams which had troubled him during the preceding night. He still complained of some dizziness when he moved his head rapidly to either side, but this symptom was not as severe as had been previously noted. He also complained of some pain and soreness at the base of the skull, but massage relieved this condition to a great extent.

During the time he remained on board the U. S. S. *Holland*, from June 8 until June 15, 1929, it did not become necessary to return him to the recompression chamber. At the expiration of this period he was transferred to his ship, the U. S. S. *Argonne*. He was still weak when he arrived on board and examination showed that his right forearm was much weaker than the left. The soreness at the base of his skull and dizziness following quick movements of his head gradually disappeared. There were no other symptoms. As the weakness of the right forearm persisted, he was transferred to the United States Naval Hospital, San Diego, Calif., on June 22, for further treatment. He was finally discharged to duty August 16, 1929, after 70 days on the sick list.

*Editor's note*—In reviewing the above report of a case of caisson disease developing as a result of a dive, one is at once impressed by the inadequate decompression administered. There is no blame attached to the supervising personnel, because they apparently followed the diving manual to the letter, but it is often necessary to follow the spirit of the law. Nine times out of ten no trouble would have occurred. This was the tenth time. This man was brought direct to the surface, after an hour on the bottom at 103 feet (45.8 pounds gauge). He had probably been working hard. Assistants who are not highly trained and not continuously working with divers can not bring one from deep water to the deck, remove a helmet, inspect a diving dress, readjust the dress, replace the helmet, and return the man to the first stage in less than five minutes. It is questionable if a well-trained diving crew could do it. That interval of time permits much to happen to the nitrogen in the blood and other tissues of the body. And yet, decompression in this case was started as though the man had been brought up after a normal dive and completed according to the original scheme. It must be remembered that the tables indicate the minimum time and are designed to prevent all but an occasional minor skin rash after a normal dive of a certain specified length.

As for treatment, when the patient was seized with dizziness, nausea, vomiting, pain in his right elbow, and numbness of his right side he should have been immediately dressed in a diving dress and put over the side, since no recompression chamber was available, and placed under pressure again as quickly as possible. Taking

him aboard the U. S. S. *Partridge* and administering symptomatic medicinal treatment was bound to fail. Reexposure to pressure, one of our very few specific remedial measures, was all important at this time. His symptoms began about two hours after the removal of his suit. He was subject to distressing symptoms and exquisite pain for about two hours before he was recompressed on board the U. S. S. *Ortolan*. These two hours were undoubtedly wasted.

Again, during and after the first decompression on board the U. S. S. *Ortolan* the patient vomited several times. Also, when he was lying in the recompression chamber for about five hours not under pressure he complained of severe photophobia, dizziness, nausea, and, moreover, these symptoms were steadily increasing in severity. He should have been placed under pressure on the appearance of these symptoms. When they appeared during decompression, the pressure should have been increased until they subsided. The delay of five hours was just that much wasted time. It is questionable whether the delay had any bearing on the final outcome in this case. It is certain, however, the patient was caused needless suffering.

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#### AN OUTBREAK OF MEASLES ON BOARD THE U. S. S. "NEW MEXICO"

By F. H. HAIGLER, Commander, Medical Corps, United States Navy

A draft composed of 20 recruits from the United States naval training station, Great Lakes, Ill., was received on board the U. S. S. *New Mexico* on May 19, 1929, while the ship was undergoing repairs and annual overhaul at the navy yard, Bremerton, Wash. After having been examined by the medical officer the men were assigned to the recruit division. During the examination each recruit was required to expose his abdomen and chest and was carefully inspected for symptoms or signs which might reveal the presence of a case of the acute exanthemata. The examination included an inspection of the mouth and throat in addition to the routine search for cases of venereal diseases. No attempt was made to segregate this draft from the other members of the crew, as each recruit appeared to be free from disease.

A typical case of measles developed among the recruits on May 23, 1929, and the patient was transferred directly to the United States naval hospital, Puget Sound, Wash. On the same day 19 contacts, consisting mainly of recruits with whom the patient had been in close association, were also transferred to the hospital for observation and isolation. Seventeen of the contacts were returned to the ship June 4 and discharged to duty after having been under observation for a period of 12 days. The day before these men

were returned from the hospital two of the crew were admitted to the sick bay aboard ship with coryza of a mild type, and developed a typical measles rash two days later. One of the patients was a marine and the other, a member of the engineer's division, was assigned to the boat crew force. Both men had been attached to the ship for several months and neither gave a history of contact with the recruits.

On June 5 another marine was admitted to the sick list with a common cold, which was followed in two days by the typical rash and other signs characteristic of measles. A seaman, second class, from the deck division was admitted with measles, June 6, and a mess attendant and a third member of the marine detachment developed the disease two days later. The mess attendant gave no history of previous contact with those who contracted the disease.

With the exception of the first case which was transferred to the hospital, all patients were treated aboard. The ship left Bremerton June 5 and arrived at San Pedro, Calif., on June 10, 1929, when the six cases of measles, together with 22 contacts, were transferred to the United States naval hospital, San Diego, Calif. All of those who were messmates of men who developed measles, or who were closely associated with them during work or in the capacity of friends, were considered contacts.

Cases then appeared in the second or No. 2 turret division as follows: June 13, 1 case; June 16, 1 case; June 18, 1 case; June 20, 2 cases; and June 21, 2 cases. All of these patients were transferred to the United States naval hospital, Mare Island, Calif., but no more attention was paid to contacts, as it was now apparent that the entire crew could be considered as such. The outbreak which comprised a total of 13 cases suddenly subsided and no more cases of measles were admitted after June 21.

At the onset of the epidemic all contacts were segregated in the crew's reception room, as this space was the only compartment of sufficient size in which they could be isolated until they were transferred from the ship.

Following the outbreak of the disease a daily inspection of the crew was made by the medical officers. The abdomen and chest of each man was exposed and inspected for rash, and a close examination was made of the eyes and throat for early symptoms of the disease. The crew was instructed to be in the open air as much as possible and report at sick bay at first sign of rash, cold, or fever. Close supervision of the scullery was maintained in order to secure complete sterilization of mess gear. The nipples on drinking fountains were taken off and boiled twice daily, and the soda fountain was temporarily closed.

All cases were typical in character, of moderate severity, and all made an uneventful recovery. With one exception all patients denied a previous attack of measles. It is not definitely known whether or not the disease was brought aboard by the draft of recruits, as measles was at that time very prevalent both in Bremerton, where the crew was freely granted liberty, and in Seattle.

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**A FATAL CASE OF POISONING BY NEOARSPHENAMINE PRESENTING SOME UNUSUAL FEATURES**

Fatal cases resulting from a more or less remote luetic infection are reported, from time to time, in which due and proper weight has not been given to the effect of treatment with arsenical preparations on the final outcome. It is the desire of the Bureau of Medicine and Surgery to record as accurately as possible all deaths which may logically be attributed to acute or chronic poisoning resulting from the administration of these preparations. In the case about to be described, and which illustrates this point, bronchopneumonia was reported as the primary cause of death and syphilis as the secondary cause.

The patient, at the time of his death on June 1, 1929, was a boatswain's mate, second class, 40 years of age. He first enlisted in the Navy on February 14, 1908, when his weight as recorded was 131 pounds. Upon his first reenlistment his weight was 137 pounds, and, at the time of subsequent reenlistments, ranged from 150 pounds in 1915 to 155 in August, 1927.

According to his health record, he was admitted with gonorrhoea in June 1912, and with a "typical chancroid" November 2, 1912. The ulcer healed, and he was discharged from treatment on November 23, 1912. He was subsequently admitted with syphilis on December 4, 1912, and transferred to hospital for treatment. The health record contains a notation to the effect that after exposure the patient took the prophylaxis offered. On admission he complained of a severe headache, and physical examination revealed an indurated ulcer situated near the frenum, a maculo-papular eruption, and general glandular enlargement. The blood Wassermann reaction was strongly positive. He received mixed treatment, 0.6 gram., salvarsan December 10, and was discharged to duty, as with no open lesions, December 30, 1912, after 26 days on the sick list.

No other entries appear until January 18, 1915, when he was admitted with chancroid. On March 12, 1915, the blood Wassermann reaction was strongly positive and he was again transferred to hospital for treatment. From March 13 to April 30, 1915, he received

five intravenous injections of neoarsphenamine, or a total of 4.5 grams; two intravenous injections of arsphenamine, or 1.2 grams; and 7 intramuscular injections of succinimid of mercury, or 0.31 gram. The blood Wassermann reaction, Noguchi modification, which was strongly positive on admission, became negative April 28, and he was discharged April 30, 1915, with no open lesions.

After return to duty aboard ship he received 13 intramuscular injections of salicylate of mercury or 0.845 gram during the period May 4 to July 27, followed by 2 injections, or 0.13 gram, of the same preparation, and 5 injections, or 0.34 gram, succinimid of mercury intramuscularly from September 7 to November 22, 1915. It is recorded in the health record that the blood Wassermann reaction was negative on January 1, 1916, and that he received weekly injections of succinimid of mercury, four-fifths grain each, for a period of four months.

Apparently no more antiluetic treatment was administered to this patient until January 9, 1924, when he received a single injection of 0.45 gram neoarsphenamine. On January 29 a blood Wassermann reaction performed at the Royal Naval Hospital, Naples, Italy, was reported as 4 plus. An intensive course of antiluetic treatment was started March 5, and continued until June 30, 1924. During this time he received 2 intravenous injections of 0.45 gram and 11 injections of 0.9 gram, or a total of 10.8 grams neoarsphenamine, and 13 intramuscular injections reported as containing 0.1 grain each of bichlorid of mercury, or a total of 0.08 gram. It is interesting to note that on three different occasions, as reported in the health record, he received 0.1 grain bichlorid of mercury and 0.9 gram neoarsphenamine the same day.

The cerebrospinal fluid was withdrawn and examined aboard ship on June 28, 1924. The cell count was normal and Wassermann reactions made with 0.1, 0.2, and 0.3 cubic centimeter of the fluid gave negative results. From July 4 to July 21, 1924, he received seven more intramuscular injections, containing 0.1 grain each, totaling 0.04 gram bichlorid of mercury. On August 18, 1924, he was admitted with gonorrhoea presumably contracted at Antwerp, Belgium. A negative blood Wassermann reaction was recorded September 13, 1924.

No further treatment was accorded this patient until March 16, 1925, when 0.45 gram neoarsphenamine was administered. The reason for resuming treatment was not stated. Eight hours after receiving this injection he developed a profuse macular rash which faded completely within 48 hours. This may have been a Herxheimer reaction but more probably was a warning signal indicating an intolerance on the part of the patient to further arsenical medi-



cation. The day after the injection blood was withdrawn and the serum forwarded to the United States Naval Medical School, Washington, D. C., for a Wassermann test which was reported 4 plus, four days later. Treatment was apparently discontinued until April 10. From that date to May 22, 1926, he received six intramuscular injections of succinimid of mercury, or a total of 0.08 gram. A negative blood Wassermann reaction was recorded October 27, 1926, and again March 20, 1927, but the Kahn test, November 1, 1927, gave a 4 plus reaction. The reviewer notes that there seems to be considerable lack of agreement between the various Wassermann and Kahn tests, some being reported as negative and some as 4 plus. It is quite possible that this discrepancy is due to the technique employed rather than to the tests per se.

According to the treatment listed on the reverse of the syphilitic abstract, the patient received five intravenous injections of an arsenical, presumably neoarsphenamine, during the period of time November 8 to December 20, 1927, but no entry regarding the preparation used, dosage employed, or reaction observed following the injection appears to have been made in the health record.

On February 1, 1928, or about six weeks after receiving the last injection of neoarsphenamine, he was admitted with simple anemia on board a destroyer and transferred to a hospital ship as evidently in need of prolonged careful medical treatment. It may be mentioned that from this point on an excellent history is recorded.

When questioned on board the hospital ship, he gave a history of weakness, dyspnea, sensation of faintness upon walking, blurring of vision, and nasal hemorrhage. According to the patient's accepted statement he had always been strong and robust and felt well until he started the last course of neoarsphenamine on board a receiving ship in November, 1927. After the first injection he was placed in a bunk in the sick bay on account of itching of the skin, fever, and a spotted rash on the legs. The individual lesions comprising the rash were reddish in color, not raised above the level of the surrounding skin, and about the size of a dime. This rash was undoubtedly due to capillary hemorrhage. After three days' rest in bed he returned to duty. The following week the injection was omitted, but two weeks from the time he received the first injection he was given a second. He felt worse after this, the rash was still present on his legs, but he had no chills or fever. At the expiration of another week he received a third injection, following which he felt worse, and blood began to ooze from his nose. One week later he received his fourth injection with exacerbation of the symptoms caused by the preceding injections. The rash gradually disappeared, but was replaced by small areas of minute hemorrhages on the legs,

thighs, nose, arms and thorax. It is interesting to note here that upon the advice of the chief pharmacist's mate on board the receiving ship he discontinued the course of neoarsphenamine.

Apparently there is a discrepancy in the recorded data. The entry on the reverse side of the syphilitic abstract indicates that five injections of neoarsphenamine were administered in November and December, 1927, while according to the statement of the patient recorded on February 1, 1928, but four injections are accounted for.

About two weeks before he was transferred he had a course of mercurial rubs after which bleeding from the nose and the sensation of weakness increased. A physical examination on board the hospital ship revealed pallor of the skin and mucous membranes but no emaciation. Blood-pressure readings were, systolic 112 and diastolic 68. Blood examination showed hemoglobin, 35 per cent; red blood cells, 1,520,000 per cubic millimeter; blood platelets, 36,480; and white blood cells, 3,300 with 82 per cent lymphocytes. He was placed on a liver diet and given transfusions of citrated blood as follows: February 7, 500 cubic centimeters; February 14, 750 cubic centimeters; February 21, 750 cubic centimeters; February 27, 750 cubic centimeters; March 14, 500 cubic centimeters; and March 25, 650 cubic centimeters. A blood examination March 30 showed hemoglobin, 65 per cent; red blood cells, 3,010,000 per cubic millimeter; blood platelets, 30,100; and white blood cells, 4,600 with 55 per cent lymphocytes.

He was transferred to a naval hospital April 5, 1928, with the recommendation that a splenectomy be performed. The medical officer who had charge of the case expressed the opinion in the health record that the patient had an aplastic anemia caused by arsenical poisoning and that while repeated transfusions have increased the number of red blood cells, they have had little effect upon the number of blood platelets, and that unless transfusions are repeated the number of red blood cells will diminish.

One week later an entry was made in the health record by a medical officer at the hospital stating that the blood picture indicates an anemia of a primary type with no evidence of regeneration suggesting an aplastic condition possibly caused by an arsphenamine. Transfusions of whole blood were given at the hospital as follows: May 5, 750 cubic centimeters; July 21, 500 cubic centimeters; and July 25, 500 cubic centimeters. On August 13, the hemoglobin was 75 per cent and the red blood cells, 4,330,000. He was discharged to duty August 21, 1928.

Nothing further occurred until January 21, 1929, when he fell, striking his head and shoulder on a locker while changing his clothes in a civilian establishment ashore. He was brought aboard.

the destroyer to which he was attached the following morning in an unconscious condition, put to bed under observation for 24 hours, and then transferred to a naval hospital. A physical examination revealed a partial paralysis of the left side which was attributed to a cortical lesion in the left post-central gyrus involving the facial and upper extremity area probably from a gumma or a small cerebral hemorrhage. A blood examination January 24 showed hemoglobin, 83 per cent; red blood cells, 4,210,000 per cubic millimeter, and white blood cells, 8,050, with polymorphonuclear leukocytes 64 per cent. The Kahn test gave a 4 plus reaction with the blood, but a negative reaction with the cerebrospinal fluid withdrawn two days later. He was placed upon potassium iodid in increasing doses. An examination of the cerebrospinal fluid withdrawn February 18 gave a colloidal gold curve of 1, 2, 3, 4, 4, 4, 3, 2, 1, 1. One month later he had sufficiently recovered so that he was permitted to be up and about the ward.

The final course of antiluetic treatment was started April 13, 1929. The course consisted of the following injections:

#### NEOARSPHENAMINE

April 13, 0.45 gram intravenously.  
April 20, 0.40 gram intravenously.  
April 27, 0.60 gram intravenously.  
May 7, 0.75 gram intravenously.  
May 11, 0.75 gram intravenously.

#### BICHLORIDE OF MERCURY

April 19, 0.021 gram intramuscularly.  
April 26, 0.021 gram intramuscularly.  
May 3, 0.021 gram intramuscularly.  
May 10, 0.021 gram intramuscularly.

About May 19 he returned to the hospital from liberty in an intoxicated condition. Following this, he began having hemorrhages from the mouth and nose, and an area of ecchymosis appeared over the face.

On May 29, or 18 days after the last injection of neoarsphenamine, jaundice appeared, and a blood examination revealed hemoglobin, 21 per cent; red blood cells, 1,320,000 per cubic millimeter; and white blood cells, 1,800, recorded as 100 per cent lymphocytes. The next day he was given a blood transfusion of 700 cubic centimeters. Symptoms of broncho-pneumonia appeared the following day and death occurred June 1, 1929, or 21 days after the last injection of neoarsphenamine had been administered.

The autopsy findings were:

Cerebral softening from previous apoplexy; vascular lues; nasal hemorrhage, anatomical site unelicited; profound secondary anemia; pulmonary edema; broncho-pneumonia; myocardial degeneration; early Laennec's type of hepatic cirrhosis; nephrosis; passive congestion of the viscera.

It would seem from the above data taken from the health record that death in this case may be properly charged to arsphenamine therapy. The blood picture is fairly typical of the aplastic type of anemia which sometimes follows the administration of arsenic. As mentioned above, if reactions followed any or all of the four or five injections of neoarsphenamine administered in November and December, 1927, they were either not observed or not recorded. On February 1, 1928, however, it is stated that a general erythematous eruption followed the first of these injections. There is also evidence of a rash developing within a few hours after the patient received an injection of 0.45 gram neoarsphenamine on March 16, 1925. Such cutaneous reactions are well known to occur after the administration of an arsphenamine to an individual with an intolerance for arsenic. The necessity for the careful observation of patients and the recording by medical officers of all reactions which may occur following the injection of an arsenical preparation is therefore obvious. It may be stated in this connection that Dickens' modification of Autenrieth's test for the presence of arsenic in the urine of patients who have received an arsphenamine is of great practical value and particularly applicable in the cases of those who are receiving injections of an arsenical preparation after having completed previous courses of intensive antiluetic treatment. This test is described in the United States Naval Medical Bulletin, April, 1929, page 509.

The patient in the case under review developed a hemorrhagic rash after having received repeated injections of neoarsphenamine, which in turn was followed by an anemia of an aplastic type. He apparently recovered sufficiently to enable him to return to duty. Further administration of neoarsphenamine caused the reappearance of an anemia more profound in character, which resulted in death. For statistical purposes the primary cause of death in this case has been recorded as syphilis and the secondary cause as acute poisoning by neoarsphenamine.

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#### VACCINE ADMINISTERED TO 22 MEN EXPOSED TO RABIES

By J. B. KAUFMAN, Captain, Medical Corps, United States Navy

There is maintained by the destroyer squadrons at the target repair base, situated in a section of San Diego known as La Playa, a repair party, which at the time of the occurrence cited in this article, con-

sisted of 30 men with a chief boatswain's mate in charge. The detail was composed of about an equal number of men attached to two destroyer squadrons, Nos. 11 and 12, of the Battle Fleet, but most of them were selected from the crews of the two tenders, U. S. S. *Melville* and the U. S. S. *Altair*. They are berthed and live in tents and have a mess shack where food is prepared and served to them by a ship's cook, who is one of the detail.

At the time the detail was sent from the *Altair* on March 25, 1929, the men were accompanied by a dog, which had been a pet on board the ship for the past three years and whose good nature was so appreciated by the ship's company that he was generally petted and pampered. So far as can be determined by questioning the various members of the detail, this dog was apparently in good health and showed no signs of ill health until May 31. On the preceding day roast turkey had been served at mess, and, as his share of the ration, the dog had received a generous supply of turkey bones which he seemed to eat with relish. On the following day it was noticed that he had difficulty in swallowing and appeared to choke when trying to drink water. At this time he apparently showed no other symptoms and various members of the detail who saw him thought that a turkey bone had become lodged in his throat. It was also noticed that he drooled saliva in profuse quantities but was in no way vicious and made no attempt to snap at or bite anyone.

Certain members of the party decided that they would make an attempt to remove the bone which they believed was lodged in the animal's throat. They accordingly forced his jaws open and not only made a close visual inspection of the throat with the idea of locating the bone, but also thrust their hands into his mouth and their fingers down his throat for the purpose of dislodging the bone.

They persisted in these procedures for some time but were unsuccessful, as in all probability no bone was lodged in the throat. Several men attempted to force water down his throat with the aid of a hose to overcome the apparent thirst, which he appeared unable to relieve. Later in the day it was noticed that the dog was worse, inasmuch as he refused all food and drink and seemed weaker, yet no suspicion of rabies arose, and the members of the detail decided to give him some purgative medicine. This medicine, which happened to be castor oil, was forced down his throat that evening.

In all of these first-aid procedures a large percentage of the men seemed to be actively interested either in holding the animal's mouth open, digitally examining the throat, forcibly feeding water, or administering medicine. Apparently the dog showed no improvement, so on June 2 he was taken by one of the detail to a veterinary at a dog and cat hospital in San Diego and left for observation and

treatment. On the following day, June 3, the dog died and the brain was examined for rabies.

At no time did the detail make any attempt to report the dog's illness to the medical department of the U. S. S. *Altair*, and it was only by accident that the information reached the medical officer of the destroyer squadrons. A radioman, third class, attached to one of the destroyers mentioned to the medical officer of the division to which his ship was attached, that at La Playa he had been playing with a dog which he understood had "gone mad" and he wondered whether or not he should receive treatment. The divisional medical officer failed to realize that the destroyer squadrons maintained a working party at La Playa, and believing it a shore activity, verbally reported the incident to the acting district medical officer while visiting the hospital. It was investigated and on June 5 a letter was addressed by the acting district medical officer to the squadron's medical officer citing briefly the facts and stating that the brain of the dog was being examined at the city laboratory. About an hour before the letter reached the squadron medical officer a radiogram was received from the same official stating that the laboratory reported the presence of Negri bodies in the brain tissue of the dog and that the case was definitely one of rabies.

Two medical officers were immediately detailed to proceed to La Playa and make a thorough investigation in order to determine the actual necessity for the administration of rabies vaccine to those exposed. After considerable difficulty in finding all of the possible contacts, since many were out with destroyers, the entire detail was mustered and returned to the U. S. S. *Altair*. They were questioned closely and those who undoubtedly had had no contact with the dog were returned to their duties while the remaining members were held aboard the tenders for treatment.

It was difficult to determine which of the contacts had abrasions or open lesions of any kind on their hands at the time of exposure, although at the time of examination unhealed and recently healed abrasions were noted on the hands of nine members of the detail, and one man had a well developed acne involving the hands. There seemed no question but that these men should receive treatment and in the cases of the remaining twelve who had played such a conspicuous part in the first-aid procedures it was deemed advisable to give them the benefit of treatment. One member of the detail was indefinite in his statements, though he did not believe he had experienced any close contact with the dog and showed no sores or abrasions on his hands, but nevertheless he desired the treatment. He was included with the contacts.

On June 8 a dispatch was sent to the naval medical supply depot at Mare Island requesting a supply of rabies vaccine sufficient for

25 men and asking that it be delivered by air mail, if possible. An immediate reply to this dispatch stated that none of the vaccine was in stock and advised purchase in the open market. The senior medical officer of the U. S. S. *Melville* was therefore instructed to purchase the necessary vaccine in the open market. After the order had been placed and all the vaccine in stock in Los Angeles, fourteen days treatment for six persons, was enroute with more to follow when procurable, word was received from the supply depot that 25 14-day treatments were being shipped. The vaccine obtained by open purchase was received by air mail while the vaccine from the supply depot arrived later but in time to be used in the prophylactic treatment of those exposed. It was noticed that each of the two lots of vaccine had been produced in different laboratories. They are designated in this article by the key letters A and B, respectively.

The first injection of vaccine was given to each of the 22 contacts on June 10 and injections were continued daily for a period of 14 days. Heavy work and severe exercise were prohibited and all men were warned of the danger from indulgence in alcoholic beverages during the period of vaccination. Eleven were injected on board the U. S. S. *Melville* and the same number on the U. S. S. *Altair*, but, as the former vessel sailed on June 13 for the navy yard, one of the contacts, who was going on leave, which was to be spent in San Diego, continued his treatment on board the U. S. S. *Altair*. The injections were administered in various parts of the body and the reactions following injections may, for the most part, be described as negative. One man who was given vaccine A on board the U. S. S. *Altair* exhibited distinct evidence of shock within a few minutes after he received the inoculation. He had a pulse rate of 40 beats per minute; respiration, 14; temperature, 97° F., and stated that he felt weak and dizzy but was not apprehensive about his condition. He was immediately placed in bed but reacted before any stimulation could be administered.

It is believed that the dose was given intravenously by accident, as in none of the succeeding injections did he show a reaction. The other few reactions observed consisted of mild headaches, slight nausea, dizziness, and a moderate degree of nervousness, although in one case on board the U. S. S. *Melville* a severe headache with other milder symptoms that persisted for several hours was noted after the first injection. As would be natural, there was some local soreness at the site of the injection but this was negligible.

Up to the time this article was written, July 8, 1929, or one month after the initial doses of vaccine were injected, neither had any untoward aftereffects been reported nor had any of the contacts developed signs or symptoms of rabies.

The prophylactic treatment, in our opinion, seemed justified, but no comment on the relative merits of the vaccine used appears to be called for. In some cases on board the U. S. S. *Altair* there was an unfortunate mixing of vaccines and men who were started on vaccine A were continued on vaccine B. From the literature accompanying these products this seemed to be not contraindicated, although, for the purpose of comparing the two products, the data proved useless.

It would appear from the best history we can obtain in the case of the dog that the weakness, characteristic of the paralytic stage in cases of rabies, developed first in the muscles of the jaw, although there apparently was no well-developed "jaw drop."

In writing this article I am indebted to the medical officers of the U. S. S. *Altair*, U. S. S. *Melville*, and the Thirty-fifth Division, Destroyer Squadrons, Battle Fleet, for their assistance and the excellent data furnished in their memoranda.

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#### THE USE OF RABIES VACCINE ON BOARD SHIPS OF THE YANGTZE PATROL

By A. M. LARSEN, Lieutenant Commander, Medical Corps, United States Navy

Because of the prevalence of rabies in the Yangtze Kiang River Valley, orders were transmitted by dispatch in 1928 to ships of the Yangtze patrol. The orders are as follows:

0116. In view of the fact that there were three cases of rabies last year and three patients were bitten by a rabid dog this year, it is directed that no dogs be allowed on board any ship of the Yangtze patrol. 1030.

7513. Due prevalence rabies in Yangtze ports, all ships of the patrol operating at or above Hankow shall submit requisitions and keep in stock at least three courses of rabies vaccine. Vaccine can be procured at municipal laboratory, Shanghai. 0930.

It may be recalled that two deaths from rabies occurred on board the U. S. S. *Pigeon* in 1927.

The following report submitted by Lieut. (J. G.) G. W. Smith, Medical Corps, United States Navy, gives the details regarding the three persons exposed to rabies in 1928:

On June 6, 1928, while I was on duty on the U. S. S. *Monocacy* in Changsha, China, a small dog on the ship began acting queer and showed a tendency to snap at the sailors passing by on the deck. On examining the dog it snapped at me and caused a superficial lesion on my right index finger. I immediately cauterized the wound and kept the dog under observation.

The dog grew more restless and irritable. It seemed to want to run, and that night it broke loose from its rope and ran around the deck all night long, but fortunately nobody was bitten. The irritability increased and an inability



to keep down foods of any kind developed. The food would be taken into his mouth, but he was unable to swallow, due to a convulsive seizure of the diaphragm and abdominal muscles. However, water could be taken, but soon the ability to retain that was lost. The dog gradually became weaker and more emaciated. A slow paralysis of the hind legs seemed to be developing, but there was comparatively little foaming at the mouth. All loose objects near at hand were savagely bitten, and this characteristic continued until the dog was too weak to raise its head. The dog died on June 11.

The dog was autopsied and the gastrointestinal tract was negative for worms. No evidence of gross pathology in the thorax or viscera existed. On removing the brain the chisel slipped from the dog's brain, through my rubber glove, and into my right thumb. This wound was cauterized about one hour later.

A smear from the cut section of the cerebellum and cornu ammonis showed the presence of numerous Negri bodies, which conclusively established the diagnosis of rabies.

After the dog began acting suspiciously I learned that two other men had been bitten on the fingers by this dog on June 4 and June 6, respectively, but they had not reported at the time of the biting, hence no local treatment of the wound was effected.

A radio to Hankow asking for antirabies vaccine on June 7 was complied with, the serum arriving in Changsha at 8 p. m. June 10. Treatment of the two men and myself was begun immediately. The vaccine received was prepared at Shanghai Municipal Laboratory in April, 1928, and from the scant information obtained it had evidently been kept on ice.

The Semple antirabies vaccine is a phenolized uniform emulsion consisting of 21 injections to be delivered into the abdominal wall. However, one paragraph in the instructions gave me some alarm. It stated, "We are advising such patients as can proceed to Shanghai to do so, and are only recommending its use for those who can not proceed to Shanghai and as preliminary treatment for patients on their way to Shanghai."

I immediately sent a radio to the commanding officer of the Yangtze patrol asking for instructions, for I did not want to take chances on an unknown vaccine.

The three patients were transferred to Shanghai, China, where they each received a full course of antirabic treatment prepared, by the Semple method, at the Pasteur laboratory of the Shanghai Municipal Council. No symptoms developed in any case. Arrangements were made to have every ship in the patrol keep at least two courses of vaccine in stock. The cost of vaccine sufficient for a single course was \$10, Mexican currency, with the privilege of renewal, free of charge, if returned to the municipal laboratory, Shanghai, prior to the date of expiration. One course of vaccine was used on board the U. S. S. *Helena* while at Kiukiang, as prophylactic treatment in the case of a person who had been bitten by a dog suspected of having rabies. It is felt justifiable for ships operating in isolated sections to keep a stock of this vaccine constantly on hand.

**AN OUTBREAK OF FOOD POISONING CAUSED BY BOILED SMOKED HAM**

An outbreak of food poisoning occurred on board the U. S. S. *Holland* between 4 and 5 p. m. on June 1, 1929. The ship was then at anchor in San Diego Bay, Calif.

The following account is based on a report submitted by Lieut. Commander Grover C. Wilson, Medical Corps, United States Navy, senior medical officer of the ship. The suspected food was boiled smoked ham which formed a part of the noon meal on that date. The menus for May 31 and for breakfast and for the noon meal on the succeeding day are as follows:

*May 31, 1929*

BREAKFAST	DINNER	SUPPER
Fresh fruit.	Fried fish.	Clam chowder.
Fried eggs.	Tartar sauce.	Crackers.
Fried bacon.	Fried potatoes.	Steamed vienna sausages.
Hot cinnamon snalls.	Spanish beans.	Spaghetti.
Bread, butter, and coffee.	Banana shortcake.	Creamed potatoes.
	Bread, butter, and coffee.	Hot rolls, butter, and tea.

*June 1, 1929*

Fresh fruit.	Bean soup.
Rolled oats and milk.	Crackers.
Baked pork and beans.	Bolled ham.
Catsup.	Bolled cabbage.
Bread.	Bolled potatoes.
Butter.	Boiled carrots.
Coffee.	Sour pickles.
	Cottage pudding and sauce.
	Bread, butter, and coffee.

About 400 men ate the suspected food and 63 were attacked. Of these, 60 who were mildly affected were treated at the sick bay and returned to duty. The remaining were admitted to the sick list. They were not seen by a medical officer until about 12 hours after they became ill for the reason that none were on board at the time and the hospital corpsman on watch did not consider the cases of sufficient severity to call a medical officer until about 4 o'clock the following morning. He then called the medical officer of the guard ship. Ham was the only food eaten by all the men who subsequently showed symptoms of food poisoning. It appeared to be in excellent condition but several of the men stated that it "tasted bad."

Symptoms of poisoning appeared in from four to five hours after the noon meal. All of those who became ill were similarly attacked. The onset was sudden and was accompanied by prostrating

spasmodic abdominal pains, chills, diarrhea with loose watery stools, vomiting which persisted from a few hours to about 24 hours in the most severely affected, alternating flushing and pallor, frontal headache, and slight muscular soreness. There was a slight irregular fever in a few cases. The highest temperature observed was 102° F. There was no apparent disturbance of pulse or respiration. In general, the pulse varied as the temperature. The blood pressure was not taken and no white blood cell counts were made. No toxicological or bacteriological examinations were made of the food, vomitus, stools, or urine, and none of the suspected food was fed to laboratory animals.

The hams were purchased from the San Diego branch of a prominent packing concern on United States Navy contract about three weeks before they were used. They were apparently in good condition when they were received on board and were properly stored. On the morning of June 1 some of the hams were cleaned, prepared for cooking, and boiled in a large steam kettle. They were then sliced and served at noon in the general mess.

It is believed that one or possibly more of the hams had become contaminated with a microorganism of the enteritidis-paratyphoid group of bacilli, but that no gross changes were detectable at the time the hams were cooked and served. All patients recovered, most of them within a few hours. The patient most severely afflicted was transferred to a naval hospital. He returned to duty nine days after he became ill with symptoms of poisoning.

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**UNSAFE PRACTICE RESULTING IN TWO CASES OF FOOD POISONING  
ATTRIBUTED TO CANNED MILK ON BOARD THE U. S. S. "WORDEN"**

Canned evaporated milk is not ordinarily regarded as a potent source of food poisoning. It is a well-known fact that cans, when intact, will preserve this milk in a wholesome condition over long periods of time even under the most adverse and varied climatic conditions. It is also a well-known fact that the milk is subject to deterioration as in the case of fresh milk or cream when the cans are opened or when it is removed from the cans.

Two members of the crew of the U. S. S. *Worden* suddenly became ill with symptoms of food poisoning on March 3, 1929, about four hours after breakfast. They were robust, healthy men and hearty eaters. The meal consisted of corn flakes, evaporated milk, fried eggs, bread, butter, and coffee. Evaporated milk taken from a can which had been opened the evening before was taken with corn flakes and coffee by the two who were poisoned. Two other

men of the mess who used the same milk but in much smaller quantities suffered very slightly. The remaining members of the crew ate the same meal but experienced no ill effects.

The symptoms observed were prostration, weakness, spasmodic abdominal cramps, slight chills, cold clammy skin, vomiting, diarrhea, occipital headache, rapid pulse, 110 to 120, and shallow rapid respiration.

The suspected milk, due to the fault of the mess cook, had been left in the open can which was allowed to remain in a warm compartment overnight. The can was thrown over the side after breakfast. Treatment consisted of ipecac to induce copious vomiting followed by large quantities of sodium bicarbonate in warm water and later with hot black tea. All symptoms disappeared in about six hours, leaving the patients comfortable but feeling very weak. Loss of time, two days in each case.

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#### HEALTH OF THE NAVY

The general admission rate, all causes, based on returns for April, May, and June, 1929, was 323 per 1,000 per annum as compared with 551, the corresponding rate for 1928. The median rate for the second quarter of the preceding five years is 502.

The admission rate from disease was 293 as compared with the median rate for the corresponding three months of the five preceding years, which is 457. The admission rate from accidental injuries was 30 per 1,000 per annum. The median rate for the 5-year period, 1924 to 1928, second quarter, is 51.

Due to cold unseasonable weather, common acute infections of the respiratory type exceeded expectancy at the United States naval training station, Great Lakes, Ill. There were 88 cases of catarrhal fever in April, 101 in May, and 89 in June. The senior medical officer of the station reported that the number of admissions could doubtless have been materially reduced by assigning many individuals to light duty. He considered this to be a poor policy, however, and insisted that all men with fever and symptoms of coryza, even though mild, be admitted to the sick quarters for observation.

An outbreak of acute tonsillitis, which began in February at the United States naval training station, San Diego, Calif., continued into the second quarter of the year. There were 35 cases in April, 29 in May, and but 10 in June. Scarlet fever, which was present at this station to the extent of 7 cases in March, also continued

with 4 cases in April, 2 in May, and 3 in June. In this connection it is interesting to note that tonsillitis and scarlet fever were undoubtedly introduced on board the U. S. S. *New York*, where they reached epidemic proportions in March, from ports in the vicinity of San Diego. Five cases of scarlet fever developed at the United States naval training station, Great Lakes, Ill. in June among recruits attached to two different companies. Both companies were immediately isolated upon the appearance of cases and all individuals were given the Dick test. Each person, in addition, was carefully examined for early symptoms of scarlet fever. In one company 92 negative and 27 positive reactions were observed and in the other company the reactions were 105 negative and 23 positive. All of those giving positive reactions were transferred to hospital for isolation and observation as scarlet fever contacts. No other case of the disease has been reported since June 24.

An outbreak of measles, comprising 21 cases, occurred at the United States naval training station, Hampton Roads, Va., in April. Apparently effective control measures were promptly instituted, as no other case of the disease was reported during the remainder of the quarter. Mumps, which exceeded expectancy at this station during the period January to March, inclusive, continued to be prevalent. The incidence of the disease, however, decreased from 38 cases in April to 7 in June. This station also reported 9 cases of German measles in April, 8 in May, and 3 in June. The corresponding figures for this disease at the United States naval training station, San Diego, Calif., were 24, 11, and 1.

Cerebrospinal fever exceeded expectancy in most sections of the United States in 1928 and in 1929. Eight cases with five deaths occurred at shore stations in the United States during the second quarter of 1929. The distribution was as follows: United States naval training station, San Diego, Calif., 2 cases in May; United States naval training station, Newport, R. I., 1 fatal case in May; United States naval air station, Lakehurst, N. J., 2 fatal cases in April; and United States Marine Corps base, San Diego, Calif., 1 fatal case in April. One case, the first since September, 1927, developed at the United States naval training station, Hampton Roads, Va., in April. A midshipman of the fourth class developed cerebrospinal fever at the United States Naval Academy, Annapolis, Md., May 14 and died the following day. Two fatal cases occurred among expeditionary forces—one at Shanghai, China, April 15, and the other at Managua, Nicaragua, May 25. One case of Paratyphoid fever was reported by the United States naval hospital, San

Diego, Calif., in May. Infection was presumably acquired in the vicinity of San Diego.

The admission rate, all causes, for forces afloat was 256 per 1,000 per annum as compared with an expectancy of 457. Reports and returns from forces afloat in general indicate that excellent health conditions prevailed during the quarter.

A small outbreak of mumps, consisting of 11 cases, occurred on board the U. S. S. *Holland* in June. The U. S. S. *Tennessee* reported one case of typhoid fever in May. Two fatal cases of cerebrospinal fever developed in April, one on board the U. S. S. *Texas* and one on board the U. S. S. *Sturtevant*. The U. S. S. *Arkansas* and the U. S. S. *Pittsburgh* each reported a case in May. About 180 men in a draft from the United States naval training station, Newport, R. I., arrived at San Diego, Calif., June 30, on board the S. S. *Mongolia* and were immediately placed in quarantine because of cerebrospinal fever. One case occurred en route. The patient died one day before the vessel docked. A case of smallpox, hemorrhagic in type, was reported by the U. S. S. *Pittsburgh* in June. The patient became ill while ashore in Shanghai, China, but did not return to the ship until the following day. A generalized papular hemorrhagic rash appeared four days after he was attacked and death occurred four days later.

TABLE No. 1.—Summary of morbidity in the United States Navy and Marine Corps for the quarter ended June 30, 1929

	Forces afloat	Forces ashore	Marine Corps	Entire Navy
Average strength.....	75,564	41,286	19,403	116,850
All causes:				
Number of admissions.....	4,842	4,593	1,558	9,434
Annual rate per 1,000.....	256.31	444.90	321.19	322.94
Disease only:				
Number of admissions.....	4,331	4,198	1,411	8,549
Annual rate per 1,000.....	230.32	406.72	290.88	292.65
Communicable diseases, exclusive of venereal diseases:				
Number of admissions.....	1,188	2,091	482	3,279
Annual rate per 1,000.....	62.89	202.59	99.37	112.25
Venereal diseases:				
Number of admissions.....	1,975	601	416	2,576
Annual rate per 1,000.....	104.55	58.23	85.76	88.18
Injuries:				
Number of admissions.....	485	393	147	878
Annual rate per 1,000.....	25.67	38.08	30.30	30.06
Poisoning:				
Number of admissions.....	6	1	0	7
Annual rate per 1,000.....	.32	.10	0	.24

TABLE No. 2.—Deaths reported, entire Navy, during the quarter ended June 30, 1929

Primary	Secondary or contributory	Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
Average strength.....		8, 675	1, 633	86, 465	1, 179	18, 408	490	116, 850
CAUSE, DISEASES								
Abscess, entamebic, liver.....	None.....			1				1
Abscess, peritonsillar.....	Embolism, inferior mesenteric artery.....					1		1
Appendicitis, acute.....	Peritonitis, general acute.....			1				1
Cellulitis, right leg.....	Septicemia.....			1				1
Cerebrospinal fever.....	None.....		1	6		3		10
Carcinoma, lung.....	Pleurisy, suppurative.....			1				1
Endocarditis, acute.....	Pericarditis, acute.....			1				1
Do.....	Valvular heart disease, combined lesions, aortic and mitral.....			1				1
Filariasis, general.....	Enteritis, acute.....			1				1
Gastroenteritis, acute.....	None.....					1		1
Glioma, left cortex, motor area.....	Pneumonia, broncho.....					1		1
Influenza.....	do.....			2				2
Do.....	Endocarditis, acute ulcerative (malignant).....			1				1
Do.....	Septicemia.....			1				1
Leukemia.....	None.....			1				1
Measles.....	Mastoiditis, acute.....					1		1
Myocarditis, chronic.....	None.....					1		1
Do.....	Arthritis, chronic, left knee.....			1				1
Do.....	Dilatation, cardiac acute.....			1				1
Obstruction, intestinal, from external causes.....	None.....			1				1
Osteomyelitis, mandible.....	Meningitis, cerebral.....	1						1
Pneumonia, lobar.....	Pleurisy, suppurative.....			2				2
Do.....	Pleurisy, serofibrinous.....			1				1
Pericarditis.....	Pleurisy, suppurative.....			1				1
Pneumonitis, chronic nontuberculous.....	Embolism, cerebral.....			1				1
Scarlet fever.....	Pneumonia, broncho.....			1				1
Syphilis.....	Aneurysm, abdominal, aorta.....					1		1
Do.....	Myocarditis, chronic.....			1				1
Do.....	Poisoning, acute, neoarsphenamine.....			1				1
Tonsillitis, acute.....	Pneumonia, broncho.....					1		1
Tuberculosis, pulmonary, chronic.....	None.....			3				3
Do.....	Chirrhosis, liver.....			1				1
Tuberculosis, pulmonary, acute general miliary.....	None.....			1				1
Do.....	Pericarditis, chronic.....			1				1
Tuberculosis, pulmonary, acute pneumonic.....	Measles.....			1				1
Tumor, brain.....	None.....			1				1
Ulcer, duodenum.....	Peritonitis, local, acute.....			1				1
Ulcer, stomach.....	None.....			1				1
Valvular heart disease, combined lesions, aortic and mitral.....	do.....	1						1
Total for diseases.....		2	1	39	2	8		52
CAUSE, INJURIES AND POISONING								
Burns, multiple.....	Crush, chest, legs, and abdomen.....			2				2
Contusion, face.....	Persistent thymus gland.....			1				1
Crush, chest.....	None.....					1		1
Drowning.....	do.....			8		1		9
Fracture, compound, skull.....	do.....	1		3				4
Do.....	Alcoholism, acute.....			1				1

TABLE No. 2.—Deaths reported, entire Navy, during the quarter ended June 30, 1929—Continued

Primary	Secondary or contributory	Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
CAUSE, INJURIES AND POISONING—continued								
Fracture, compound, thoracic vertebra.	Wound, punctured, thoracic cavity.			1				1
Fracture, simple, skull.	Rupture, traumatic, spleen.			1				1
Fracture, simple, skull and cervical vertebra.	None			1				1
Injuries, multiple, extreme.	None	4		3		3		10
Do.	Myocarditis, chronic.	1						1
Rupture, traumatic, liver.	Hemorrhage, traumatic, mesenteric artery.			1				1
Rupture, traumatic, spleen.	Intraabdominal hemorrhage.			1				1
Strangulation, neck.	Dementia, precox.			1				1
Wound, gunshot, neck, spinal cord and abdomen.	None					1		1
Wound, penetrating brain.	do				1			1
Wound, incised, neck.	Psychosis, unclassified	1						1
Poisoning, commercial muriatic acid.	Intestinal obstruction from internal causes.			1				1
Poisoning, acute, acetanilid.	None			1				1
Poisoning, acute, chloroform, inhaled.	do			1				1
Poisoning, opiates, acute.	Alcoholism, acute			1				1
Poisoning, barbital, acute.	Edema, lungs			1				1
Total for injuries and poisoning		7		29	1	6		43
Grand total		9	1	68	3	14		95
ANNUAL DEATH RATE PER 1,000								
All causes		4.15	2.45	3.15	10.18	3.04		3.25
Disease only		.92	2.45	1.81	6.79	1.74		1.79
Injuries		3.23		.74	3.39	1.08		.99
Drowning				.37		.22		.31
Poisoning				.23				.17

### STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by naval training stations:

Cumulative data	Number	Per cent of recruits received	Per cent of recruits reviewed
<i>Jan. 1 to Dec. 31, 1928</i>			
All naval training stations:			
Recruits received during the period	13,589		
Recruits appearing before Board of Medical Survey	611	5.50	
Recruits recommended for discharge from the service	410	3.02	67.10
<i>April, May, and June, 1929</i>			
United States naval training station, Hampton Roads, Va.:			
Recruits received during the period	602		
Recruits appearing before Board of Medical Survey	13	2.16	
Recruits recommended for discharge from the service	13	2.16	100.00



Cumulative data	Number	Per cent of recruits received	Per cent of recruits reviewed
<i>April, May, and June, 1929—Continued</i>			
<b>United States naval training station, Great Lakes, Ill.:</b>			
Recruits received during the period.....	923		
Recruits appearing before Board of Medical Survey.....	18	1.95	
Recruits recommended for discharge from the service.....	11	1.19	61.11
<b>United States naval training station, San Diego, Calif.:</b>			
Recruits received during the period.....	1,090		
Recruits appearing before Board of Medical Survey.....	12	1.09	
Recruits recommended for discharge from the service.....	12	1.09	100.00
<b>United States naval training station, Newport, R. I.:</b>			
Recruits received during the period.....	626		
Recruits appearing before Board of Medical Survey.....	63	10.06	
Recruits recommended for discharge from the service.....	15	2.40	23.81

The following cases, selected from reports of medical survey recently received by the bureau, are presented to indicate conditions existing prior to enlistment which led to early separation from the service. These conditions were so evident that the men should have been rejected at their respective recruiting stations.

The men, in the following cases, were all apprentice seamen with less than one month's service. Physical defects responsible for their discharge from the Navy were discovered when they were reexamined at a naval training station within a few days after they were enlisted.

**Chronic nephritis.**—Enlisted at Little Rock, Ark., June 1, 1929. Urinalysis disclosed a large amount of albumin with many granular and hyaline casts. Daily examination of the urine over a period of 12 days failed to show improvement. No improvement followed rest in bed and milk diet. Surveyed June 17, 1929.

Enlisted at Little Rock, Ark., May 17, 1929. Examination revealed a large quantity of albumin, granular and hyaline casts in the urine, and blood pressure of 142/90. His condition did not improve during a period of 19 days. Surveyed June 10, 1929.

Enlisted at Kansas City, Mo., June 8, 1929. When examined at a naval training station his urine was found to contain a large quantity of albumin, and many granular and hyaline casts. He was anemic and had puffiness under the eyes. He showed no improvement at the end of 15 days. Surveyed July 27, 1929.

Enlisted at San Francisco, Calif., May 6, 1929. Urinary findings were the same as in the above cases. The blood pressure was 152/90. He was under observation for 19 days but showed no improvement. Surveyed May 27, 1929.

**Otitis, media, chronic.**—Enlisted at Cleveland, Ohio, June 12, 1929. Upon examination the left external auditory canal was filled with pus having a foul odor, and there was a perforation of drum membrane which was thickened and retracted. Surveyed June 17, 1929.

Enlisted at Omaha, Nebr., June 24, 1929. History of mastoiditis with operation in 1924. Examination showed a purulent discharge from left ear with defective hearing 3/15 and tenderness over the mastoid region. He also had deviation of nasal septum, enlarged turbinate, and was unable to breathe through his nose. There was an old fracture of the right leg with 1½ inches shortening, together with a decided lordosis and scoliosis. The right shoulder was two inches lower than the left. Surveyed July 3, 1929.

Enlisted at New York, N. Y., August 1, 1929. History of chronic discharge from right ear since early childhood. Examination revealed perforation of the drum, depressed arches, and poor physique. Surveyed August 5, 1929.

*Deformity.*—Enlisted at Boston, Mass., August 3, 1929. Examination revealed an old fracture of left clavicle with considerable deformity. Second and third toes both feet, webbed. Unable to carry rifle. Surveyed August 24, 1929.

Enlisted at Philadelphia, Pa., July 2, 1929. History of infantile paralysis during early childhood resulting in deformity of both feet. Exaggerated arches were associated with faulty weight bearing. There were also inability to move all except the great toe and hammer toes, left foot, and paralysis of left occipitofrontalis muscle. Surveyed July 6, 1929.

Enlisted at Baltimore, Md., May 21, 1929. This man had a pronounced lateral curvature of the spine and wry neck with head held habitually to the right. Surveyed May 24, 1929.

*Constitutional inferiority.*—Enlisted at Newark, N. J., July 29, 1929. History of leaving school at the age of 16 years while in the third grade. Examination revealed defective color perception, defective vision, enlarged tonsils, deformity of the nose, and a healed fracture of the mandible. Surveyed August 6, 1929.

Enlisted at Boston, Mass., August 14, 1929. He had thickening of one ear drum, enlarged tonsils, deviated nasal septum, and defective hearing, 8/15, both ears. He was dull and inattentive mentally, anemic, and poorly developed. Surveyed August 24, 1929.

*Undescended testicle.*—Enlisted at Boston, Mass., June 14, 1929. Examination disclosed a thin poorly nourished individual, 10 pounds underweight, with moderate lordosis. The left testicle was undescended. He had been rejected one year previously for enlistment in the Marine Corps. Surveyed June 19, 1929.

*Hernia.*—Enlisted at Dallas, Tex., August 14, 1929. Examination disclosed a small right bubonocoele. The contents were reducible and disappeared when a reclining position was assumed. He refused operation. Surveyed August 28, 1929.

*Organic heart disease.*—Enlisted at Providence, R. I., June 4, 1929. History of scarlet fever and tonsillitis. This recruit was found to have a systolic mitral murmur heard over the apex and back and transmitted to the left axilla. Blood pressure varied from 102/70 to 130/90. Schneider index 15. Tonsils were enlarged and crypts filled with caseous material. Surveyed June 19, 1929.

*Dental defects.*—Enlisted at Raleigh, N. C., August 5, 1929. This man had only 13 sound teeth. Of the remainder, Nos. 2, 3, 4, 8, 9, 12, 16, and 19 were missing, and Nos. 5, 6, 14, 18, 21, 22, 27, and 30 were carious. Nos. 7 and 10 were replaced by a bridge. Surveyed August 12, 1929.

*Flat feet.*—Enlisted at Birmingham, Ala., June 14, 1929. He had depressed arches, hammer toes, and was 40 pounds overweight. "Weight bearing tends to fall on inner aspect of feet." Surveyed June 10, 1929.

The following apprentice seaman was in the Navy a little more than one month:

*Sequelae of lethargic encephalitis.*—Enlisted at Buffalo, N. Y., May 6, 1929. Symptoms of involvement of the central nervous system were noticed at a naval training station before this man received an outfit of clothing. He was placed under observation at a hospital where he was found to have Parkinson's syndrome, a sequel of lethargic encephalitis. Surveyed June 20, 1929.

## ADMISSIONS FOR INJURIES AND POISONING, SECOND QUARTER, 1929

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the second quarter, 1929, is based upon all Form F cards covering admissions in those months which have reached the bureau:

	Admissions, April, May, and June, 1929	Admission rate per 100,000 per annum	Admission rate per 100,000 year, 1928
<b>INJURIES</b>			
Connected with work or drill.....	418	1,431	2,852
Occurring within command but not associated with work.....	300	1,027	1,855
Incurred on leave or liberty or while absent without leave.....	160	548	1,189
All injuries.....	878	3,006	5,846
<b>POISONING</b>			
Industrial poisoning.....	2	7	27
Occurring within command but not connected with work.....	1	3	125
Associated with leave, liberty, or absence without leave.....	4	14	42
Poisoning, all forms.....	7	24	194
Total injuries and poisoning.....	885	3,030	6,040

## Percentage relationships

	Occurring within command				Occurring outside, command—leave, liberty of A. W. O. L.	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty			
	April, May, and June, 1929	Year, 1928	April, May, and June, 1928	Year, 1928	April, May, and June, 1929	Year, 1928
Per cent of all injuries.....	47.6	48.8	34.2	31.7	18.2	19.5
Per cent of poisonings.....	28.6	13.8	14.3	64.4	57.1	21.8
Per cent of total admissions, injury, and poisoning titles.....	47.5	47.7	34.0	32.8	18.5	19.5

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction," or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from April, May, and June, 1929, reports, are worthy of notice from the standpoint of accident prevention:

*Gasoline hazards.*—A seaman, first class, after spilling gasoline on his clothes, neglected to remove them. He received a chemical burn of the abdomen. Loss of time, 6 days.

*Firearms, careless handling of.*—Due to his own negligence a marine left a shell in the chamber of a service revolver when he removed the magazine.

He received a gunshot wound of the left thigh when he accidentally pulled the trigger. Loss of time, 19 days in a hospital.

*Unguarded open spaces.*—A floor plate in the engine room was removed and, because of the negligence of others, the open space was left unguarded. The usual standing light was not burning. A machinist's mate, first class, suffered a strain of the muscles of the back when he stepped into the opening. Loss of time, 6 days.

*Unsafe practice, careless handling of lines.*—A seaman, first class, was attempting to clear a line from a block which was being used in hoisting a motor launch. Due to his own negligence his hand became caught in the line and was drawn into the block. Multiple wounds of the hand resulted. Loss of time, 32 days.

*Steam hazards, faulty material.*—A fireman, first class, received burns of the right forearm and left shoulder while using a steam hose in cleaning the bilges aboard ship. The hose parted from the coupling to which it had been faultily secured with a piece of wire. Loss of time, 5 days.

*Unsafe practice.*—An aviation carpenter's mate attempted to adjust a belt without shutting off the power. He received contusions of the third and fourth fingers when his fingers were caught between the belt and the pulley. Loss of time, 7 days.

*Inadequate safety device.*—While a seaman, first class, was operating a joiner his hand slipped and became caught in the machine. He sustained compound fractures of a finger. Loss of time, 32 days. It was reported that the safety device installed did not afford adequate protection.

*Laundry machine hazards.*—A seaman, first class, received a lacerated wound of the scalp when, because of his own negligence, it was reported that he accidentally fell into a washing machine. His head was caught by the heavy metal door. Loss of time, 8 days in a hospital.

*Unsafe practice, carrying an open knife down a ladder.*—An engineman, first class, who was carrying an open knife, slipped while on a ladder leading to the engine room and received a lacerated wound of the right hand. The wound required five sutures. The case was reported as "negligence apparent." Loss of time, 10 days.

*Faulty material.*—While inspecting sentries, a corporal of the Marine Corps stepped into an opening in the dock due to a broken plank which had not been replaced. He sustained a lacerated wound of the leg. Loss of time, 54 days. Negligence of others was undoubtedly a contributory factor.

*Heat cramps.*—A fireman, third class, 18 years of age with but one year's naval service, suffered an attack of heat cramps while on duty in a hot fireroom. While working directly under a blower he drank large quantities of ice water. The disease was recorded as "due to his own negligence." Loss of time, 4 days.



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*Washington, March 20, 1907.*

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,  
*Acting Secretary.*

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## PREFACE

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The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April, 1907, as means of supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes, and comments on topics of medical interest, and reviews or notices of the latest published medical books.

The bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of commendation to authors of papers of outstanding merit and will recommend that copies of such letters be made a part of the official records of the officers concerned.

The bureau does not necessarily undertake to indorse all views or opinions which may be expressed in the pages of this publication.

C. E. RIGGS,  
*Surgeon General United States Navy.*

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# U. S. NAVAL MEDICAL BULLETIN

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## SPECIAL ARTICLES

### COMBINED PRECIPITATION (KAHN)—COMPLEMENT FIXATION (BASS) TESTS IN THE SERUM DIAGNOSIS OF SYPHILIS<sup>1</sup>

#### A PROCEDURE UTILIZING NATURAL HEMOLYSIN AND COMPLEMENT IN HUMAN BLOOD SERUM

By J. E. HOUGHTON, Lieutenant Commander, Medical Corps, United States Navy, and  
H. S. SUMERLIN, M. D., Pathologist, Rees-Stealy Clinic, San Diego, Calif.

The identity of the precipitin and complement fixing substances in syphilitic blood serum was suggested by Jacobstahl in 1908. The essential unity of the Kahn precipitation and complement-fixation tests has been demonstrated by Kahn (1) and in the laboratories of the United States Naval Medical School by Houghton (2). Following the completion of the Kahn test, guinea-pig complement was added to the serum-antigen mixtures and incubated in the water bath at 37° C. for 30 minutes to permit fixation of complement; then hemolytic amboceptor and washed erthrocytes added and again placed in the water bath. The complement was fixed in specimens showing definite flocculation, while hemolysis occurred in the absence of precipitation, in most instances giving a reaction identical with the various Wassermann methods.

The anomolous nature of the two reactions is a paradox from the standpoint of immunology. It is impossible to explain the relationship or offer a satisfactory theory regarding the fixation of complement or the formation of the precipitates in mixtures of syphilitic blood serum and alcoholic extracts of tissue lipids and cholesterol. However, when these extracts are mixed with the serum from syphilitic individuals in definite concentrations a visible precipitate is formed or the complement is fixed. Although the tests are performed in the absence of a specific antigen, there appears

<sup>1</sup> From the laboratories of the U. S. Naval Hospital, San Diego, Calif., and the Rees-Stealy Clinic, San Diego, Calif.

to be a biological specificity in precipitation and complement fixation tests in the presence of the spirochetal diseases, yaws and syphilis. Stokes (3) in a recent paper considers certain diseases as true nonspecific or biologically false positive reactions, and among these he includes framboesia or yaws, leprosy, the acute exanthemata, and other febrile and cachetic diseases. It would be out of place to attempt an academic discussion of yaws and syphilis in this paper, but it has been conclusively shown by many workers that the Kahn and Wassermann reactions are as specific for yaws as for syphilis. In the nonsyphilitic leper and in the absence of the "leper reaction" following the treatment of leprosy, the Kolmer-Wassermann and the Kahn tests have given consistently negative results. Certain of the exanthematous diseases and malaria do yield false positive reactions during the febrile periods, and it is unfair to a laboratory test, such as one for syphilis, to expect absolute biological specific reaction in the absence of a specific antigen. On the other hand, the possibility of latent syphilis is brought to light in some cases by intercurrent diseases and pregnancy.

The classical Wassermann test taught physicians how valuable a clinical aid it is in differential diagnosis, and their knowledge has been little advanced through the various modifications of the test. For many years efforts have been made by many serologists to develop a test which would equal or excel the Wassermann, and this has led to the development of a test almost as protean as the disease it represents. Precipitation or flocculation tests have been introduced to supplant the various Wassermann modifications, and the adoption of the Kahn test by several State and city public health laboratories and the United States Navy as the standard serum test for syphilis has been considered a radical departure from the staid methods in use for more than 20 years. A comparative study of the Kahn test and the standardized "Wassermann tests" has yielded a remarkable parallelism of results and indicates a remarkable degree of specificity for the two reactions.

Since many physicians now employ these tests for syphilis as a routine procedure in diagnosis without regard to physical findings, the responsibility of the diagnosis of syphilis is too often left to the laboratory report without further appraisal of the patient. Realizing the importance of the precipitation and Wassermann tests as the most important *single manifestation* of syphilis, some syphilologists now refuse to accept a report based on a single type of procedure. The two tests employed together demonstrate the essential unity of precipitin and complement fixation, although occasional reactions are observed in which precipitation occurs in

the absence of complement fixation, and, conversely, complement may be fixed without visible flocculation. This "serologic discord" (4) is apparently most often noted between parallel tests employed with different Wassermann "methods" using different antigens than when the Kahn and a standardized Wassermann procedure, such as the Kolmer (5), are used.

With the employment of the two separate tests as widely variant as the Kahn and Wassermann in the same laboratory, the time and labor involved is an important factor, and the expense of securing capable technicians is beyond the reach of many clinics. While the Kahn test does not detect all cases of syphilis, it certainly approaches the maximum of any biological test so far devised, and if only one test is employed the standard Kahn 3-tube test is the one of choice. The only disadvantage of the Kahn is the difficulty some workers encounter in the reading of precipitates which closely resemble the macroscopic bacterial agglutination tests. This disadvantage is overcome with the addition of the hemolytic system, and the results are read in the same manner as with the Wassermann test.

In the laboratories of the United States Naval Medical School we found that the antishoop (Wassermann) and the antihuman (Noguchi) hemolytic systems gave equally good results when added to the completed Kahn tests. With the antishoop system we employ one-tenth of the quantities used in the Neill (6) modification of the Wassermann test used in the United States Public Health Service. For the antihuman system complement, amboceptor and red cells are used in the same quantities as in the Noguchi test (7). Only one tube of the standard Kahn test is used (12:1 serum-antigen mixture), as the stronger antigen-serum mixtures are anticomplementary, due to the large amount of antigen. A control tube containing the patient's inactivated serum is employed in the same manner as in the standard tests. Primary fixation in the ice box (6°-10° C.) may be used with the antishoop method, but no additional information is gained through this prolonged method of incubation over a 30-minute period at 37° C. water bath.

The fact that the Wassermann test could be performed without the addition of sera from foreign species was demonstrated by Bass (8), who showed that normal hemolysins of an amboceptor structure are present in human blood serum in considerable quantities for the erythrocytes of the guinea pig. He also utilizes the natural complement present in fresh human serum. Kolmer and Casselman (9) state that 98 per cent of human blood serum does not contain natural hemolysin for guinea-pig red cells and only 2 per cent shows as much as 25 per cent hemolysis in a 0.2 c. c. quantity. We have

found that practically all fresh human blood serum contains sufficient hemolysin and complement in 0.05 c. c. to completely hemolyze 0.1 c. c. of a 10 per cent suspension of washed guinea-pig red cells. In more than 2,500 specimens we failed to obtain complete hemolysis in only 0.7 per cent of sera, and this could readily be attributed to "complementoids," which may bring about the anticomplementary complement fixation tests.

#### TECHNIQUE OF THE COMBINED KAHN-BASS METHOD

The only reagents employed in this method are the blood serum from the patient, standard Kahn antigen, a 10 per cent suspension of washed guinea-pig corpuscles, and 0.9 per cent sodium-chloride solution. The apparatus used is the standard Kahn test equipment (10)—racks, tubes, etc.

Blood is obtained from the patient in the same manner as for the Kahn or Wassermann test, allowed to clot, and centrifuged at high speed to completely precipitate the red cells. Then 1 to 2 c. c. of the clear serum is pipetted off for the Kahn test and the remaining serum for the complement fixation test. Serum 24 hours old left at room temperature (22° C.) gives satisfactory results, but it is preferable to store in the ice box to avoid excessive bacterial contamination. Specimens more than 48 hours old require the addition of fresh negative human serum to the test to restore the complement.

The suspension of the guinea-pig corpuscles is prepared by bleeding full-grown guinea pigs from the heart into sodium-citrate solution (0.5 c. c. of 2.5 per cent sodium citrate in 0.9 per cent sodium chloride to each 4.5 c. c. of blood). With proper technic, from 5 to 10 c. c. of blood may be obtained from the same animal every five or six weeks. Place the citrated blood in graduated centrifuge tubes and rapidly centrifugalize until the erythrocytes are completely precipitated. The supernatant serum-citrate fluid is carefully decanted or pipetted off without disturbing the cells, fresh saline added, the tube thoroughly shaken and again centrifugalized. This washing is repeated three times to free the cells from serum. The total column of packed cells is read on the graduated scale of the centrifuge tube and added to sufficient normal saline to make a 10 per cent suspension. The washed cells keep well in the ice box for at least 72 hours.

Titration of cell suspension, natural amboceptor and complement, is carried out simultaneously, using pooled fresh human serum. While this titration is unnecessary, it has demonstrated that the red cells of all guinea pigs tested are not refractory to hemolysis by human blood serum. It also shows a quantitative relationship of the strength of the cells and amboceptor complement present. The titration is outlined in Table 1.



TABLE 1.—*Titration of cell suspension and human serum*

Tube No.	Saline, c. c.	Human serum	Guinea- pig cells, 10 per cent	Usual readings after 10 to 15 minutes
1.....	0.5	0.05	0.05	Complete hemolysis.
2.....	.5	.05	.10	Do.
3.....	.5	.05	.15	Partial (75 per cent) hemolysis.
4.....	.6	.0	.10	Saline control.
5.....	.6	.025	.10	Partial hemolysis.
6.....	.5	.075	.15	Complete hemolysis.

Incubate 15 minutes at 37° C. or 30 minutes at 22° (room temperature).

It will be seen from Table 1 that 0.05 c. c. of fresh human serum completely hemolyzes 0.1 c. c. of a 10 per cent suspension of guinea-pig red cells, and that 0.15 c. c. is completely dissolved by 0.075 c. c., so that with the use of 0.1 c. c. of serum we have approximately two units plus of amboceptor and complement. While the complement and amboceptor content is not the same in all human serum, we have found that 0.1 c. c. furnishes the required amount for a satisfactory test dose.

After completing the Kahn test, 0.1 c. c. of the patient's unheated serum was added to each tube and the tubes incubated for a period of 20 to 30 minutes, and then 0.1 c. c. of 10 per cent guinea-pig cells added to each tube, and incubated again for the same period. It was found that the tubes giving definite precipitates with the Kahn did not show hemolysis, while those negative with the Kahn hemolyzed rapidly. The tube containing the 12:1 serum-antigen mixture of the Kahn test, although often containing heavy flocculi, was the weakest with the complement fixation, but the tubes containing the 6:1 serum-antigen mixture produced complete inhibition of hemolysis. This led to the determination of the optimum serum-antigen mixture to employ, and it was found that the concentration of 6:1 contained the satisfactory titre. The standard Kahn antigen, diluted as used in the routine 3-tube precipitation test, was not anticomplementary nor hemolytic for guinea-pig red cells in concentrations of 3:1 (i. e., 0.15 of serum plus 0.05 c. c. antigen suspension).

In carrying out the combined precipitation-complement fixation test we first perform the routine 3-tube Kahn test and, after reading the results, discard the front and back tubes, leaving the middle tube in place. Clean Kahn test tubes are then placed in the front row of the rack and saline added to a level in the tube approximating the serum-antigen tube (about 0.7 c. c.). Then with a capillary bulb pipette calibrated to deliver a measured number of drops per c. c., we now remove sufficient fresh (unheated) serum from the original blood tube containing the clot, add 0.1 c. c. to the front tube containing normal saline and 0.1 c. c. to the back tube containing the serum-antigen mixture. The back tube now contains 0.15 c. c. of

the patient's inactivated serum plus 0.025 antigen, 0.5 c. c. normal saline, and 0.1 c. c. of his own fresh serum. Although this would appear to be pronounced imbalance between the control tube containing only 0.1 c. c. of serum diluted with saline, it shows that the reacting substances in positive serum and the complement are closely bound, and the excess of hemolytic amboceptor which is present in the serum-antigen mixture does not interfere with the test. (When testing old sera we use 0.15 c. c. in the front tube in addition to the 0.1 c. c. of fresh negative human serum to each tube.) The tubes are then incubated in the water bath or bacteriologic incubator at 37° C. for 20 to 30 minutes and 0.1 c. c. of 10 per cent guinea-pig red cells added to all tubes and incubated again for the same period. Primary incubation in the cold (6°–10° C.) for 4 to 16 hours may be employed, but we have not been able to show any increase in sensitivity of the reaction over the 30-minute fixation in the incubator.

With the addition of fresh human serum to reactivate the complement and supplement the amboceptor in repeated tests with old positive blood serum, it was found that reheating of the serum for 15-minute periods up to 1 hour gave heavier precipitates with the Kahn tests and the complement fixation became less pronounced. This observation confirms the work of Kendrick (11) and others, who have shown that there is apparent destruction of complement-fixing substances in syphilitic serum when heated to 56° C. for prolonged periods, while there is a tendency toward stronger precipitation reactions. This suggests the duality of the "antibodies" in luetic serum, changing from thermolabile complement-fixing "reagin" to a thermostabile precipitable "substance."

Studies are being carried out on the application of this method to spinal fluids. The test is not applicable to the globulin precipitate used in the Kahn test, as the addition of ammonium sulphate produces anticomplementary reactions. However, by employing relatively larger quantities of spinal fluid with the Kahn antigen and utilizing negative human serum as complement, we have obtained satisfactory tests. The number of spinal-fluid examinations are too few to report at this time.

*Outline of combined Kahn-Bass procedure using fresh and old or heated blood serum*

Front tube (1)		Back tube (2)	
Procedure with fresh blood serum (24–48 hours old).	0.7 c. c. normal saline plus 0.1 c. c. patient's fresh blood serum.	Kahn test 6:1 serum-antigen mixture (0.025 antigen and 0.15 heated serum) plus 0.1 c. c. patient's fresh blood.	Incubate test for 30 minutes at 37° C. and add 0.1 c. c. of 10 per cent guinea-pig red cells.
Procedure with serum more than 48 hours old (heated to 56°).	0.5 c. c. normal saline plus 0.15 c. c. patient's heated serum plus 0.1 c. c. fresh negative human serum.	Kahn test serum-antigen mixture as above plus 0.1 c. c. fresh negative human serum.	Repeat incubation period and read reactions.

The results of reactions conducted with the two tests have been summarized and are tabulated in the following table:

*Results of combined Kahn-Bass tests*

Number of serums tested	Positive in both tests	Relative agreement in both	Divergence in the 2 tests	Negative in both tests
2,000	274	59	Kahn pos. } K.-B. neg. }----- 39 Kahn neg. } K.-B. pos. }----- 22	1,606

In the table above the reactions positive with both tests include all specimens giving four, three, or two plus reactions, although the majority were strongly positive in both. Relative agreement refers to those reactions in which there were weak or doubtful readings with one test and strongly positive with the other. It will be noted that there was complete divergence in 61 specimens, 39 positive Kahn sera showing negative results with the complement-fixation method and 22 positive results obtained in serums not showing visible precipitation with the routine Kahn procedure. This shows complete disagreement in 3.05 per cent of positive reactions.

#### SUMMARY AND CONCLUSIONS

Since many workers in the serologic study of syphilis now recommend the employment of the precipitation test and some Wassermann modification, it is believed that the method described is a valuable complementary check, and the addition of the anti-guinea-pig hemolytic system is a useful indicator in the interpretation of the precipitation in some instances.

The combined Kahn-Bass procedure greatly reduces the sources of error inherent in the various Wassermann methods requiring the use of a number of variable reagents and time-consuming manipulations before the results of the test are obtained.

Many physicians utilize the report from the laboratory in making a diagnosis of syphilis without regard to the clinical condition of the patient in many instances, and treatment is often instituted in patients having diseases which may at times produce nonspecific positive reactions. The responsibility for accuracy in serum diagnosis is placed directly on the serologist and the adoption of the most reliable and fool-proof methods are essential. The most dangerous error is made in basing the diagnosis of syphilis on the results of a single laboratory examination in the absence of a history of infection or clinical symptoms. The repeatedly positive reactions from a reliable laboratory are highly suggestive of active or latent

syphilis, but should be interpreted as a single manifestation of the disease. The final judge in any case should be a capable syphilologist, but from the very nature of the disease it is impossible with the present methods of physical diagnosis or clinical histories to search out all the organs in which changes of a pathological nature are progressing. It is certain that asymptomatic neurosyphilis can only be detected by carefully conducted examinations of the cerebrospinal fluid, and cardiovascular lesions due to lues are often demonstrated only by repeated serological tests.

The results of the combined Kahn-Bass method parallel the findings of comparative Kahn and Wassermann tests reported by many serologists who employ the more complex Wassermann methods. Laboratory error is reduced to a minimum due to fewer reagents and technical manipulations. This method is not devised as a short-cut procedure, but to limit the possible sources of technical errors.

This study is based on laboratory comparisons of results between the two tests without any attempt at clinical correlation at this time. The total number of specimens includes several tests on individual patients, taken at weekly intervals, and includes practically all the various pathological conditions encountered in a large general hospital and clinic, as well as a considerable number of syphilitic individuals under competent observation and treatment.

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**A FACTOR IN CANCER SUSCEPTIBILITY**

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The object of this paper is to propose for consideration and for verification by experiment a factor in the etiology of cancer which, to my knowledge, has not yet been proposed. For some time it has seemed that certain statistics on cancer, when taken together, indicated this factor unmistakably. Consequently, the well-known tendencies of cancer were reviewed, together with some experiments directly and indirectly concerned with cancer. These experiments indicate the exact nature of the cancer cell in terms of what is now known of cells genetically and it is thought best to review them first.

In the course of experimentation with the fruit fly, *Drosophila ampelophila*, a mutation occurred which was studied and reported on by Stark (1) in 1915. This mutation occurred in the sex chromosome between the genes for eye and body color. It caused varying numbers of tumors to arise in the dorsal ganglia of the bodies of the larvae, principally in the sixth and twelfth segments, which caused the individual to die before it could pupate. This gene was recessive in character and thus killed half the males. It could not affect females since no male carrying the factor could mature to be crossed with any hybrid female. The result was that an unaffected male and hybrid female produced a family containing twice as many adult females as adult males. This fly, its larvæ, eggs, and pupæ were exposed daily to a standard dose of X ray for several generations without any effect on the development of the tumor.

This tumor is described because it is a good example of a neoplasm in an experimental animal. There is another tumor in *Drosophila* which is benign and is inherited as a recessive not sex-linked characteristic. The following are characteristic of both: (1) The tumors are often multiple; (2) they do not metastasize; (3) tumors are formed in but one tissue; (4) the characteristic of tumor susceptibility is recessive.

It is apparent that here the dominant factor in the appearance of these tumors is heredity. The development in susceptibles is inevitable. However, what of the other characteristics? Because the first-named tumor was often multiple, it follows that probably other ganglionic cells, in individuals who succumbed to but one tumor, were susceptible. It seems that another factor predisposed toward the formation of tumors in particular segments; possibly increased motion at these segments. Age is another factor, in that the tumors tend to appear at the later part of the larval stage. But these predisposing causes seem of relatively little importance. That the

tumor does not metastasize as do human malignant tumors may be due to the size of the cell or the lack of a proper avenue of metastasis. The important point is that susceptible individuals will *inevitably* succumb.

The mouse is the experimental animal whose hereditary tumors have been studied the most. Cancer has been the type studied most, but since the susceptibility to sarcomata is inherited in the same way, what is demonstrated of cancer applies to sarcomata. Maud Slye (2) has reported on the heredity of tumors in mice. Her work extended over 19 years and included more than 67,000 necropsies on mice, among which there were more than 5,000 spontaneous tumors.

A study of the geneological charts in her article shows that there are points of difference between cancer in mice and the sex-linked tumor of the fruit fly. One chart concerns a family of mice in which a female with fatal mammary gland carcinoma had been crossed with a male which died of carcinoma originating in the *lung*. It was expected that all offspring would show cancer, which they did. But the significant thing is that the individuals were mated on the assumption that the two *different* tumors were the result of a totally recessive condition in exactly the *same* gene; i. e., exactly corresponding parts of corresponding chromosomes, and the results of breeding as shown in the chart bear out this assumption. This condition is comparable in part to the heredity of hair color. Black is dominant over blond, but red dominates black, the genes determining these colors being in corresponding positions in the same chromosome. Study of other charts and the text of the article illustrate this same difference between fruit flies and mice, namely, that the gene in a mouse, which is responsible for the appearance of a tumor, may carry potentialities in both its parental halves for tumors in *different* organs of the body, and tumors may appear in any or all of the organs for which the gene holds a tumor potentiality. As a matter of fact the charts show individuals, after much inbreeding, which have tumors originating in as many as four organs. The tendency for tumor to form in a particular organ runs as a strain but is apparently not exclusive. This would indicate that any mouse totally recessive for cancer is potentially tumorous in every cell in its body, but that it is particularly liable to the one for which it has a strain tendency, and that tumors do not form in every tissue of its body simply because it dies first of the tumor to which it is particularly susceptible. In the light of this, it is conceivable that every cell in the fruit fly's body was potentially tumorous, but that the strain tendency was particularly strong.

Another supposition is indicated by the presence of the gene for a benign tumor in a chromosome other than the sex chromosome in the

fruit fly. A mutation might occur in *any* germ cell chromosome which would predetermine a tumor in an adult pure for that recessive characteristic. This being the case, a cross between a hybrid for a cancer-producing gene in one chromosome and a hybrid for another cancer-producing gene in another chromosome would *not* produce offspring one-fourth of which had cancer. Such is to be expected only when hybrids for the same gene are mated. This is a supposition that supports the probability that only a small amount of cancer in man is hereditary. Even granting that many people are hybrids for cancer susceptibility, if two mated who were hybrid for the susceptibility in *different* genes, they would not produce offspring totally recessive for the characteristic in *one* gene; consequently, only a small proportion of hybrid matings would produce cancerous offspring. It will be observed, too, in studying the charts in the article that there is the same tendency toward multiplicity of spontaneous hereditary tumors to be found in mice that was exhibited by the tumor in fruit flies.

Coming now to cancer in man, it has been established beyond any question that traumatism, especially that of chronic irritation, is the important immediate cause of cancer. Practically all the occupational predispositions can be shown to come under this heading. Hoffman's (3) statistics illustrate that cancer of the skin, and especially of the scrotum, occurs from two to four times as frequently in chimney sweeps as cancer in general does in the general population, depending on age groups. Aniline-dye workers are especially predisposed to cancer of the bladder. Petroleum, tar, and parafin workers are especially liable to cancer developing on irritated spots of the hands and face. Clay-pipe smoker's cancer and cancer developing from peptic ulcers are familiar examples of the influence of chronic irritation. The increased frequency of cancer of the cervix in married women over the incidence in unmarried has been attributed to infection and irritation following lacerations of childbirth. The rarity of cancer of the penis in Jews is attributed to the practice of circumcision. In fact, a study of almost any type of tumor will show certain forms of irritation or trauma to be instrumental in causing them, and the frequency with which it is present shows it to be a very important factor.

In view of the foregoing (and from H. J. Muller's (4) work to be quoted), it appears that the nature of cancer can be stated more exactly than is usually stated in textbooks. Cancer appears to be a condition of a cell, *brought about by a recessive mutation in one of its chromosomes*, in which the rate of reproduction of the cell is so much increased and the degree of differentiation so much decreased that the cell does not function normally, and in which the degree of malignancy is generally proportional to these changes. It

appears that a mutation may occur and be transmitted in a germ cell and the characteristic probably be present in every cell of the adult organism; that there may be a tendency for tumors to develop from these cells in particular organs at a certain age and apparently without trauma; and that the "hereditary" type of tumor tends to be multiple. Multiple spontaneous tumors in man may most reasonably be explained in this manner. But this type of tumor is not the common kind in man. Characteristically, tumors in man are single, even many spontaneous ones in which, in particular cases, no definite factor of trauma can be found or in which it seems slight. We see cancer developing after irritation over many times the period it would seem necessary to touch the process off in an individual hereditarily predisposed. We see benign tumors, which may even be presumed to be hereditary, develop a malignancy which can not be explained by heredity. This is of such a common occurrence that in several types of tumors, as, for example, benign papillomata of the bladder and cystic ovarian tumors, it is considered best to extirpate the benign tumor. Another suggestive point which would indicate that most tumors occur by reason of local mutation is the fact that tumors rarely tend to form in tissue the cells of which reproduce slowly. Neuromata are rare. The nerve cells have finished reproducing at birth. There is a tendency for sarcomata to occur with *relatively* much higher frequency than cancer in the first two decades of life when the cellular reproduction in mesoblastic tissues is greatest.

This last point has evidence to support it. In H. J. Muller's report (to be quoted from later) he indicates that the effects of X rays in producing mutations apparently occur during mitosis. This seems most probable when one considers the complexity of that process and the kinetic state of the chromosomes. The order of frequency of occurrence in various organs tends to support this.

From the foregoing it appears that cancer may arise in the following two ways at least:

(1) By heredity—spontaneously, at a certain age without trauma or with very little trauma. In this case the cause is a recessive characteristic in a chromosome, presumably in every cell in the body, but with a "strain" for special organs.

(2) By trauma—in this case apparently a recessive mutation occurs in a single cell during mitosis and is caused by traumatism to a susceptible cell in a susceptible state (mitosis).

The question naturally arises: What factors increase the rate of mutation, particularly recessive mutation? Muller (4) has recently described experiments in the production of mutations in fruit flies with X ray. He exposed fruit flies to such large doses of X ray that only 11 per cent survived, and bred the survivors. Sub-



sequent generations showed that a large number of mutations had occurred in the germ cells of the exposed flies and that the rate of mutation was approximately one hundred and fifty times that in unexposed flies. Of these mutations he says: "Among the visible mutations found the *great majority were recessive*, yet there was a considerable sprinkling of dominants." (Italics mine.) To quote further:

In addition to the gene mutations, it was found that there is also caused by X-ray treatment a high proportion of rearrangements in the linear order of the genes. This was evidenced in general by the frequent inherited disturbances in crossover frequency (at least 3 per cent were detected in the *x*-chromosome alone, many accompanied but some unaccompanied by lethal effects), and evidenced specifically by various cases that were proved in other ways to involve inversions, "deficiencies" fragmentations, translocations, etc., of portions of a chromosome.

It is found that the mutation does not usually involve a permanent alteration of all the gene substance present at a given chromosome locus at the time of treatment, but either affects in this way only a portion of that substance or else occurs subsequently, as an after effect, in only one or two or more descendant genes derived from the treated gene. An extensive series of experiments now in project will be necessary for deciding conclusively between these two possibilities, but such evidence as is already at hand speaks rather in favor of the former. This would imply a somewhat compound structure for the gene (or chromosome as a whole) in the sperm cell.

Certain of the above points which have already been determined, especially that of the fractional effect of X rays taken in connection with that of the production of dominant lethals, seem to give a clew to the especially destructive action of X rays on tissues in which, as in cancer, embryonic and epidermal, the cells undergo repeated divisions (though the operation of additional factors, e. g., abnormal mitoses tending toward the same result, is thereby not precluded); moreover, the converse effect of X rays in occasionally producing cancer may also be associated with their action in producing mutations. It would be premature, however, at this time to consider in detail the various X-ray effects previously considered as "physiological," which may now receive a possible interpretation in terms of the gene-transmuting property of X rays; we may more appropriately confine ourselves here to matters which can more strictly be demonstrated to be genetic.

Further facts concerning the nature of the gene may emerge from a study of the comparative effects of varied dosages of X rays and of X rays administered at different points in the life cycle and under varied conditions. In the experiments herein reported several different dosages were made use of, and while the figures are not yet quite conclusive, they make it probable that, within limits, the number of recessive lethals does not vary directly with the X-ray energy absorbed but more nearly with the square root of the latter. Should this lack of exact proportionality be confirmed, then, as Dr. Irving Langmuir has pointed out to me, we should have to conclude that these mutations are not caused by single quanta of X-ray energy that happened to be absorbed at some critical spot. If the transmuting effect were thus relatively indirect, there would be a greater likelihood of its being influenceable by other physicochemical agents as well, but our problems would tend to become more complicated.

There is, however, some danger in using the total of lethal mutations occurring in single loci, for some lethals, involving changes in crossover frequency,

are probably associated with rearrangements of chromosomal regions, and such changes would be much less likely than point mutations to depend on single quanta. A reexamination of the effect of different dosages must therefore be carried out in which the different types of mutations are clearly distinguished from one another. When this question is settled, for a wide range of dosages and developmental stages, we shall also be in a position to decide whether or not the minute amounts of gamma radiation present in nature cause the ordinary mutations which occur in wild and in cultivated organisms in the absence of artificially administered X-ray treatment.

The paragraphs quoted show the remarkable extent of the changes and the high degree of specificity of effect of the rays on the chromosome substance. Also they seem to indicate a possible explanation of the strain tendency in mice and of degrees of malignancy. A qualitative change in the gene may account for a strain tendency, and a quantitative one account for degrees of malignancy if it is assumed that cancer arises by reason of local mutation, as Professor Muller has suggested. The probable compound nature of the gene furnishes the basis for this explanation.

The statement, "we should have to conclude that these mutations are not caused by a single quanta of X-ray energy that happens to be absorbed at some critical spot," implies that the X ray may be the *actual cause* of the mutation. But that mutations may be influenced by other agents is not altogether a theoretical possibility. Prof. H. H. Newman (5) describes experiments by W. L. Tower in which mutations were produced in potato beetles by radically changed temperature and humidity conditions. This, and the "lack of exact proportionality" between number of mutations and amount of X ray indicate that X ray and other physical agents merely *influence the rate* of an otherwise natural occurrence. Hundreds of mutations have appeared and are appearing in stocks of *Drosophila* which are kept in houses windowed with glass opaque to ultra-violet rays of sunlight, and, in addition to this, are kept in glass milk bottles. In an editorial in the *Journal of the American Institute of Electrical Engineers*, July, 1928, p. 536, the work of Drs. W. W. Coblentz and Herman Goodman is summarized. It is stated in regard to the element of light which prevents rickets that practically none of it reaches us at any time of the year because it is reflected and comes through window glass opaque to it. In view of this, it is difficult to see how ultra-violet ray could be the *cause* of mutations in laboratory stocks as implied above and as suggested in the last paragraph quoted, when these stocks are practically excluded from natural ultra-violet ray.

Furthermore, it would seem, although I have found no data to support it, that mutations occur *more* frequently in laboratory stocks than in nature. I have never seen a white-eyed or bodied fruit fly in nature, and it would seem that they would occur often

enough to be observed by one looking for them, at least once, if recessive mutations occur in nature with anywhere near the laboratory frequency. Even if mutations were as frequent in nature, they would seem to be quantitatively much less, and this amounts to practically the same thing.

In fact, the theoretical explanation of this proposed factor in cancer, in the light of these experiments, rests on the assumption that, in addition to the increase in the rate of recessive mutations by exposure to excessive ultra-violet ray, there is also an increase in the absence of it. If we let  $x$  equal the amount of X ray the organism is exposed to and  $y$  the rate of mutation, the general tendency of mutations to vary as nearly as Professor Muller has determined, with  $\sqrt{x}$  would be indicated by half of a parabolic curve, thus:

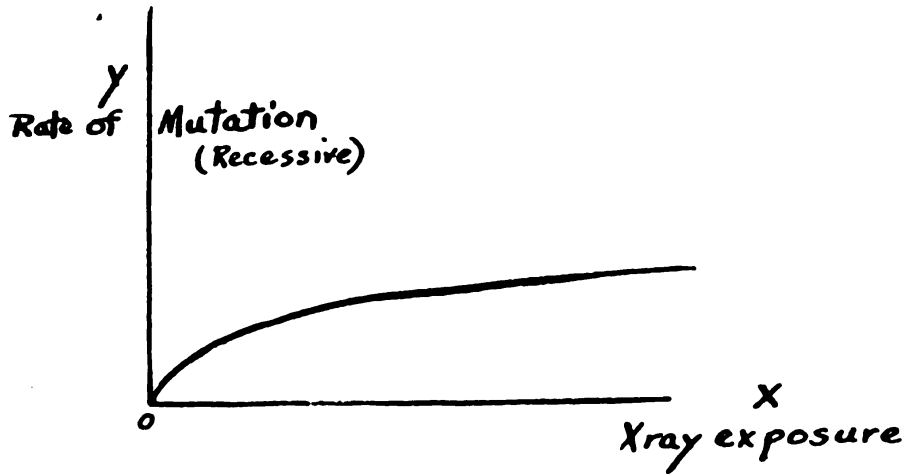


DIAGRAM 1

But if it assumed that in a state of nature the minimum of recessive mutations occurs and that in this state the rate of mutations is  $n$  and the amount of ultra-violet radiations is  $r$ , then this tendency has its apex at  $nr$  and takes this form:  $(nr)z$ .

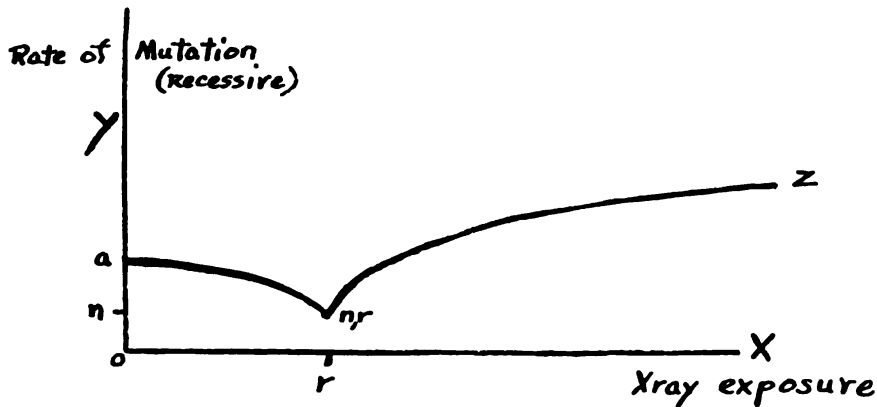


DIAGRAM 2

But if absence of sunlight has the same effect the curve should be completed by a  $(nr)a$ . It may be that subsequent experiments of Professor Muller's may show that a curve beginning with  $nr$  more nearly fits the rates of mutations than a curve beginning with  $o$ . Or the curve may be found to have no mathematical tendency but be approximately that in Diagram III, a smooth curve.

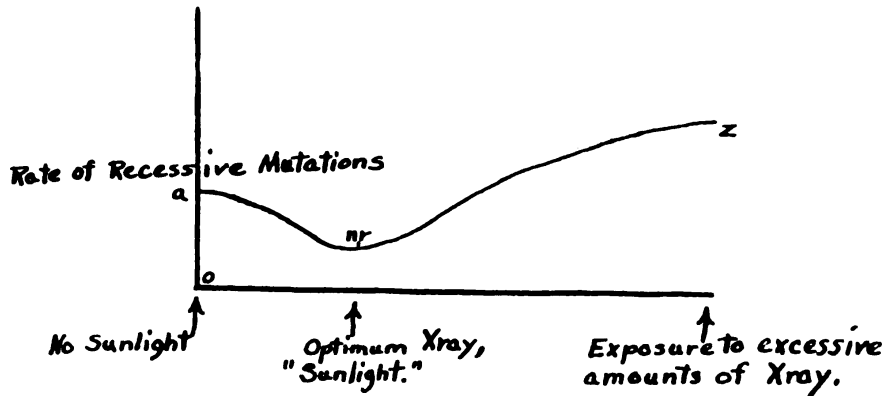


DIAGRAM 3

A more direct proof of the assumption that recessive mutations increase with lack of ultra-violet ray would be to culture flies in buildings and in direct sunlight and observe the rates of spontaneous mutation. This curve is not by any means intended to represent the mathematically exact relation between ultra-violet rays and mutations any more than is Professor Muller's approximation. It is merely meant to show diagrammatically that the rate varies to a much smaller degree than the exposure, which is all he probably intended to indicate; that the rate is probably minimum under natural conditions; and that it tends to rise again in the absence of the optimum exposure to ultra-violet ray.

Returning to cancer in man, it appears from the foregoing that, judging by the infrequency of multiple tumors and by the frequency of traumatism or chronic irritation as etiological factors, most cancer is the result of local mutation.

That one or more factors in the production of cancer are not yet known is evident. The fact that all degrees of malignancy exist, ranging from processes almost indistinguishable from mild hyperplasia of normal cells up to processes spreading at a terrific rate involving cells almost indistinguishable from embryonal cells; the fact that malignant tumors may spring from benign ones; the fact that malignant tumors may arise from slight trauma and benign ones only after much repeated trauma; the fact that, having arisen, tumors exhibit all degrees of resistance to destructive agents; these things and other characteristics of tumors make it appear very prob-

able that there is an unknown element or elements in etiology and that it or they are not inconsiderable in weight. This is commonly accepted as true, but it was thought best to outline it briefly to show the extent and because one should show room for an etiological agent to exist before advancing one.

That the unknown element or elements take the form of a susceptibility to cancer (i. e., susceptibility to recessive mutation) is probably generally felt to be the case. After reviewing the results of experiments indicating varying susceptibilities of mice to tar cancer and fowls to the *Rous sarcoma* (and probably also as a result of wide observation), W. J. Mayo (6) comes to the following conclusion:

The assumption has always been that the more severe grades of cancer are due to more potent cause. I hardly need point out that these newer revelations throw some doubt on so ready an explanation. It is equally if not more probable that the more severe forms of cancer and the development of cancer in certain tissues are due to increased susceptibility. A good general resistance with a moderate local resistance may favor development of cancer of grades 1 and 2 of Broder's classification, whereas lowered general resistance and greater local lack of resistance in certain tissues would lead to cancers of grades 3 and 4 and to a more rapid metastatic extension to tissues in various parts of the body.

In 1926, in an address on the cancer problem which I gave before the Congress of American College of Surgeons in Montreal, I made the following statement:

"The foregoing studies logically lead to the idea of increasing individual resistance to the disease and its ultimate prevention. Science has been able to develop soil changers in smallpox, diphtheria, and tetanus. Why not to cancer? Because of natural immunity to the disease, relatively only a small proportion of the total population is susceptible to scarlet fever. With the Dick test the degree of natural immunity of the individual to scarlet fever can be determined, and if it is not sufficient to protect from the disease, it can be increased to normal by serum. Why not cancer? Perhaps the development of cancer, as well as its degree of malignancy, is attributable to the diminished activity of immunizing processes rather than to the nature of the activating agent."

I wish to propose, then that the greatly diminished amount of exposure to direct sunlight that human beings in this day and age receive over a long period is probably a large underlying factor in the etiology of cancer; that is, that there is a natural optimum exposure to ultra-violet ray for man, and that in the absence of it, as well as with an excess of it, recessive mutations are more frequent. Quite a number of tendencies of cancer shown by statistics can be explained by this proposition.

It appears that more sunlight in general is the normal state for the maintenance of man's resistance to disease. The recent development of the fact that exposure to sunlight is the equivalent of vitamin D (and is probably productive of it) in the prevention and

cure of rickets further illustrates the probability that more sunlight is required. Doctors Coblentz and Goodman, in the experiments previously referred to, determined that light rays in the particular zone 290–320 millimicrons are responsible for this effect. The fact that man is *susceptible* to the benign influences of sunlight raises the supposition that at one time in his development, when his diet contained little or no vitamin D, he was actually as *dependent* on sunlight for proper bone development as he was on water for the maintenance of life. His susceptibility also raises the probability that he is still *absolutely dependent* on sunlight for as yet undetermined effects on his body. Therefore, it seems that at the very least there is room to believe that sunlight may have an effect in determining a minimum of recessive mutations if the organism receives the optimum amount.

I wish to discuss several statements and statistics to be found in Dr. F. L. Hoffman's book, *The Mortality from Cancer throughout the World*, on the assumption that most cancer is a recessive mutation brought about by varying degrees of trauma in a cell rendered liable to such mutations by diminished exposure of the whole organism to the optimum amount of sunlight. It is realized that particular figures, being the product of many factors, are not susceptible of interpretation of much value, but it is believed that any *general tendency* shown by statistics has a significance, and an attempt should be made to resolve it.

In Table 13, Appendix G, of the reference the mortality from cancer in England and Wales for males and females from 1901 to 1910 per 100,000 population by organs and parts is given in order of the relative mortality of females. I have rearranged the figures below in order of the incidence in females.

	Females	Males		Females	Males
Generative organs.....	24.46	2.31	Kidney.....	0.80	0.84
Breast.....	17.27	.14	Jaw.....	.76	2.24
Stomach.....	14.62	16.53	Lungs.....	.75	1.02
Liver and gall bladder.....	13.61	9.57	Lymphatic glands, neck.....	.62	2.17
Other intestines.....	8.13	6.40	Tongue.....	.48	4.20
Rectum.....	6.13	7.84	Pharynx, throat.....	.47	1.70
Esophagus.....	1.59	5.09	Larynx.....	.47	1.82
Peritoneum.....	1.49	.65	Mouth.....	.21	1.86
Pancreas.....	1.28	1.45	Lips.....	.10	1.21
Skin.....	1.16	1.78			
Bladder and urethra.....	.96	2.40		102.73	77.31

It will be seen that the general tendency in males and females is a parallel one and that the tendency is greatest in organs whose cells have higher rates of reproduction and more complicated function and cycles of function, in consequence of which the chromosomes are presumably more susceptible to change. The large size

of the breasts, stomach, and uterus render them more liable by reason of the greater number of cells undergoing mitosis at a given time. As has been said before, this argues against the weight of heredity and for a general susceptibility of another sort. They argue that if females did not succumb to tumors of the breast and generative organs they would to tumors of other parts at higher rates and that the total rates would then tend to approximate that of males. A few irregularities exist in the male column explainable by differences in liability to trauma or chronic irritation. Coal-tar industries probably account for the disproportion in the bladder rate. The disproportion in rates for esophagus, tongue, larynx, pharynx, throat, and lung is reasonably attributed to greater use of tobacco and alcohol in males.

The totals are characteristic of all similar statistics. Cancer mortality here is one-third more frequent in females than in males. In other statistics it is sometimes one and one-half times as frequent. Of course this tendency is accounted for in part by the very high mortality rates for malignant tumors of female generative organs because of speed of metastasis and operative difficulties. But a large part of it, I believe, is due to the fact that women in general are less exposed to sunlight than men. The majority live and work in houses, and when they go out they protect their complexions against the ravages of sunlight with parasols and cosmetics. (Attention is called to the decade of these statistics.) If approach to the optimum exposure to sunlight made the susceptibility to cancer less one would expect the cancer rate to be materially less in rural districts than in urban. This tendency has actually been noted and worked up statistically both in England and in the United States. Table 15, Appendix G, shows higher rates in rural districts for England and Wales 1911-12, but a footnote states, if standardized, the urban cancer death rates are somewhat higher than the rural rates. The rates per 100,000 population in United States Registration States are quoted for 1908-1912 (Appendix F, Part I), Table 56:

	Urban	Rural
Buccal cavity.....	2.9	2.8
Stomach and liver.....	31.3	28.0
Peritoneum, intestines, and rectum.....	11.2	7.9
Female generative organs.....	13.2	8.7
Breast.....	7.6	6.6
Skin.....	2.1	3.6
Other or not specified organs.....	13.0	9.7
	81.3	67.3

The disproportionately low rate for cancer of the generative organs may reasonably be attributed to the difficulties of accurate diagnosis of abdominal tumors in country practice. Statistics for

different occupations, by age groups, also show that the agricultural pursuits regularly show low mortality rates from cancer.

This tendency is further brought out by arranging the rates per 100,000 population for the different registration States in order for 1913:

Vermont.....	111	Wisconsin.....	78
Maine.....	107	New Jersey.....	78
New Hampshire.....	104	Minnesota.....	75
Massachusetts.....	101	Pennsylvania.....	72
California.....	97	Missouri.....	67
Rhode Island.....	93	Washington.....	53
New York.....	87	Colorado.....	50
Connecticut.....	85	Montana.....	49
Maryland.....	82	Kentucky.....	48
Ohio.....	81	North Carolina.....	47
Michigan.....	81	South Dakota.....	30
Indiana.....	81		

The incidence can be seen to be highest in urban industrialized States, where people get little sunlight and much industrial trauma, and to fall off rapidly as we approach the farm belt. The exceptionally high rates in the New England States does not appear so inexplicable when one recalls the fog-bound coast of Maine and the fog-bound condition of the Sacramento Valley of California where the population was largely centered in 1913 before the discovery of sunlight in southern California. The enormous difference between the Maine and South Dakota rates is too great to be ignored by anyone studying this question, and while partly to be accounted for by greater probability of accurate diagnosis in cities or other factors it is too great to be explained by known etiological agents. Relative exposure of populations to sunlight, I think, largely bridges the gap.

Another tendency has been observed and recorded statistically, and in the light of this tendency the differences between urban and rural rates, female and male rates, and South Dakota and Maine rates take on added significance. This tendency is shown in the following statistics, with which the comment should be quoted (*ibid*, p. 142).

The latitude is given by groups in a convenient form, but, unfortunately, most of the large cities considered are north of latitude 30°, and the aggregate population for cities south of that latitude is relatively small compared with the number of inhabitants of cities in northern latitudes. Subject to this limitation, however, the table makes an interesting contribution to the geographical study of the cancer problem.



*Mortality from cancer in cities according to latitude, 1908-1912*

Number of cities	Degrees of latitude	Population in 1912	Total population	Deaths from cancer	Rate per 100,000 population
35	60 N.-50 N.	23,980,086	112,912,675	119,374	105.7
48	50 N.-40 N.	27,519,705	131,256,257	121,216	92.4
24	40 N.-30 N.	10,198,197	47,944,253	37,451	78.1
7	30 N.-10 N.	2,780,447	13,476,168	5,696	42.3
4	10 N.-10 S.	559,630	2,583,495	1,056	40.9
7	10 S.-30 S.	1,806,951	8,066,144	3,040	37.7
5	30 S.-40 S.	2,678,287	12,297,218	11,048	89.8
130		69,520,303	328,536,210	298,881	91.0

It is shown by this table that the average cancer death rate for 130 of the world's large cities during the period ending with 1912 was 91 per 100,000 of population. The rate was highest in the most northern inhabited latitude, or that section of the globe which is comprehended within 50° and 60° north latitude. The rate for this section was 105.7, diminishing to 92.4 for cities located within 40° and 50° to 78.1 for cities between 30° and 40°, to 42.3 for cities between 10° and 30°, to 40.9 for cities between 10° north latitude and 10° south latitude, and, finally, to 37.7 for cities between 10° and 30° south latitude. In the most southerly inhabited belt, between 30° and 40° south latitude, the cancer death rate again rises to 89.8, which is practically equivalent to the rate for 30° to 50° north latitude. The table, therefore, would seem to warrant the *important conclusion* that cancer frequency is to a limited extent determined by latitude, which, of course, more or less determines the weather conditions; in other words, cancer is excessively common in the Temperate Zone, moderately common in the Medium Zone, and relatively rare in the Torrid or semi-Torrid Zone, which for the present purpose may be construed to include the belt between latitude 30° north and latitude 30° south.

He mentions climate and weather conditions, but nowhere have I seen the probability expressed specifically that the difference in the amount and intensity of sunlight to which the peoples in different latitudes were unavoidably exposed was the explanation of this tendency in cancer mortality rates or any other tendency. In fact, Doctor Hoffman mentions the theory of one observer that a slightly higher rate in fishermen than in other occupations was due to excessive exposure to sunlight. The fact that they are characteristically heavily clothed and that the cancer rates decrease with the latitudes in which few fishermen work would indicate that they were probably more susceptible by reason of insufficient rather than excessive sunlight.

The Hong Kong statistics are suggestive. A part is given here (Table 246, Appendix G) for the periods 1901-1905, 1905-1910, and for 1911 and 1912.

Years	Europeans			Chinese		
	Total population for 5 years	Deaths from cancer (5 years)	Rate	Total population for 5 years	Deaths from cancer (5 years)	Rate
1901-1905.....	53,026	26	49.0	1,453,950	79	5.4
1906-1910.....	60,744	32	52.7	1,627,970	89	5.5
	Population for 1 year			Population for 1 year		
1911.....	12,110	5	41.3	354,790	36	10.1
1912.....	12,400	6	48.4	356,020	37	10.4

These statistics may properly be objected to, first, because the population figures are small, and second, because the average expectancy of life of a Chinese is only slightly over 20 years, and the rate given is to be expected in a people who infrequently attain the cancer age. This last is somewhat minimized when one considers that Chinese in Hong Kong are largely protected by modern sanitation from the decimating epidemics which sweep China.

A table by age groups would be more accurate. But I think the low rate for the foreign population is partly explained by the fact that the amount of unavoidable sunlight is great and that foreigners of both sexes in the Orient tend to get out in it more for daily exercise. The exceptionally low rate for Chinese is partly accounted for by the fact that nine-tenths of Chinese are coolies who habitually work out in the sun with no more clothing on than a pair of short trousers in the summer.

That race susceptibility is not the weighty factor, but that exposure to sunlight most probably is, is brought out by the following quotations and discussion (*ibid.*, p. 147) :

Granting the practical difficulties of determining with accuracy the causes of death among noncivilized races, it is nevertheless a safe assumption that the large number of medical missionaries and other trained medical observers living for years among native races throughout the world would long ago have provided a more substantial basis of fact regarding the frequency of occurrence of malignant disease among the so-called uncivilized races if cancer were met with among them to anything like the degree common to practically all civilized countries. Quite the contrary, the negative evidence is convincing that, in the opinion of qualified medical observers, cancer is exceptionally rare among primitive peoples, including the North American Indians and the Esquimo population of Labrador and Alaska. Evidence is also available to substantiate the conclusion that cancer was relatively of rare occurrence among our negro population during the condition of slavery, but that the frequency rate has *rapidly* increased during the last 30 years, until at the present time cancer of the uterus is proportionally more common among negro women than among white women living *under much the same conditions of life* in the same localities. (*Italics mine.*)

The explanation in the case of Eskimos is probably that theirs is the race environment of many hundreds of thousands of years and that they have *gradually* outgrown the necessity for much sunlight. The Indian environment, too, is the same as that of their forbears. It is notorious that they have not become urbanized and industrialized. While exposed to all the deteriorating influences of civilization, they still are infrequently affected by cancer. I believe this due to the fact the Indian still lives the tribal life in the open, exposed to the sun. To quote Hoffman further:

The infrequency of cancer among the North American Indians can not be attributed to a lower proportion of persons of the cancer age, since, according to the approximately accurate data of the Thirteenth Census, the proportion of Indians aged 50 and over was 13.16 per cent in comparison with 12.3 per cent for the native white population and 10.4 per cent for the negro. In the census year 1910 there were 886 deaths from all causes enumerated among Indians living in the registration area, but of this number only 9, or 1 per cent, were deaths from cancer and other malignant tumors.

The extreme rarity of cancer among North American Indians is further confirmed by a recent inquiry of my own, made with the approval of the Commissioner of Indian Affairs, inclusive of many different tribes living in 17 different States. The replies received from agency physicians concern a full-blooded population of 52,240 and a mixed-blood population of 10,632. Among some 63,000 Indians of all tribes, living under a variety of social, economic, and climatic conditions, there occurred only two deaths from cancer as medically observed during the year 1914. The available evidence is therefore quite conclusive that malignant disease is of extremely rare occurrence among the native Indian population of the United States, and the infrequency of the disease suggests the practical importance of further research into the underlying causes or *conditioning circumstances* of their apparent immunity, as the case may be. (Italics mine.)

The question arises, Would there not be a considerable difference between the incidences in European and Chinese in Hong Kong if statistics by age groups were made?

That the rise in frequency in the negro is probably due in a large part to decreased exposure to sunlight seems to be the case when we consider that before the Civil War the bulk of the negro population, male and female, was employed in the South at cotton-plantation work where they were in the sunlight habitually and wore little clothing at work. Since the war the negroes have migrated to northern cities, a very large proportion have become urbanized, and the South has become considerably more industrialized, with a consequent decrease in the exposure of the negro to the sun. This movement of the negro race has occurred especially in the period mentioned. And when one realizes that in the period of almost two and a half centuries before the Civil War, since the introduction of negroes to America, the conditions of life have been changed in every other respect for the negro, the force of the sun-

light argument is considerably increased. He was exposed to a new set of diseases he was not afflicted with in Africa; his dietary was altogether changed; and the weather conditions differed in temperature and humidity, but he still worked in the sun. Although he was exposed to a lesser degree by reason of latitude, the exposure was not radically altered until he became established in city life. That the tendency of the negro to move toward the city accounts for the increase of cancer is supported by the opinion of another authority (*ibid.*, p. 132, quotation from part of *The Surgical Peculiarities of the American Negro*, by Dr. Rudolph Matas):

In regard to malignant neoplasms, the negro constitution has probably undergone some change under the conditions of American civilization, since it can not be doubted that cancer is comparatively rare in the native African, rare also in the original slave population in this country, and has only become a common disease in the American negro of the last few generations. It is also probable that the conditions that are causing an increase in the prevalence of cancer among the whites are also acting with the same effect upon the negroes.

The difference between the low, probably stationary, mortality in Indians living their tribe life in the open and the high and rising rate in negroes as they adopt city life under roofs and leave plantation life in the open is marked, and I think no explanation (allowing always for increased occupational irritations) fits it so well as the difference in exposure to sunlight. A mortality of 2 in 63,000 Indians is a rate of less than 4 per 100,000! Compare this with the mortality in the District of Columbia for 1901-1910 per 100,000 (*ibid.*, p. 131):

	White		Colored	
	Males	Females	Males	Females
All ages.....	70.6	104.8	38.6	86.5
40 and over.....	217.1	312.0	130.2	293.9

The argument of these statistics is that while corrections for factors may minimize the differences, as, for instance, correction for life expectancy may reduce the enormous difference in rates by latitudes, nevertheless all the tendencies noted are considered by the statistician who collected them to be indubitably present, and that differences in exposure to sunlight may reasonably explain so many tendencies that the probability of its being the explanation of any one of them is greatly increased. It should be added that these statistics are used on the assumption that the incidence rates parallel the mortality rates, etc.

Several conclusions follow from the assumption that the greater amount of cancer is due to trauma and chronic irritation to cells rendered susceptible to malignant change by the lack of exposure of the organism to the optimum amount of sunlight. Statistics indicate that a certain maximum rate exists and has almost been reached in Switzerland by the fact that the rate is high and the rate of increase small and diminishing. This would seem to parallel the fact that the rate of mutations in cultured fruit flies is apparently only moderately higher than the natural rate, when compared to the excessive rate due to X-ray exposure. This parallel only lends support to the presumption that if sunlight does influence cancer rates, as indicated, the above explanation of how cancer arises is probably the correct one. It would tend to support the assumption that the rate of mutations rises with *less* exposure of the organism to ultra-violet ray than the optimum amount of sunlight. The proof of the proposition that lack of sunlight is an etiological factor in susceptibility to cancer lies in future statistical tendencies. If, as is happening now, more and more city dwellers wear less and less clothes, exercise more in the sunlight at golf, tennis, etc., and yearly take more pride in the "healthy coat of tan" acquired at the beach, until the great majority of city dwellers are living in a larger amount of sunlight, and this new mode of life is concurrent with a diminishing rate of increase in cancer approaching a maximum far short of, say, Switzerland's, or is concurrent with an actual decrease in cancer rates, then it may reasonably be said to be a true factor, all other conditions remaining the same. There might occur a decrease in the malignancy of tumors, explainable on the assumption that optimum exposure to sunlight made the genes quantitatively less susceptible to mutation. The widespread increase in knowledge of the first signs of cancer and in the fact that chronic irritations predispose may reduce mortality without affecting incidence by reason of higher percentages of earlier, and consequently more frequently successful, operations. This tendency would tend to confuse determination. Therefore, it would appear that a reduction in the grade of malignancy would be the best index to the effect of increased sunlight on cancer susceptibility.

The experiments mentioned would tend, if positive in results, only to indicate lack of sunlight a cause if cancer arises in the manner suggested—by local recessive mutation. If exposure to sunlight of all fruit-fly stocks resulted in a reduced rate of recessive mutation the result would be positive in indicating that the general tendency indicated by the curve was correct.

If negative, it would only indicate that the *explanation of how cancer arises* is incorrect, should statistics prove in the future that a change in the mode of life of human beings in respect to sunlight actually reduced cancer rates.

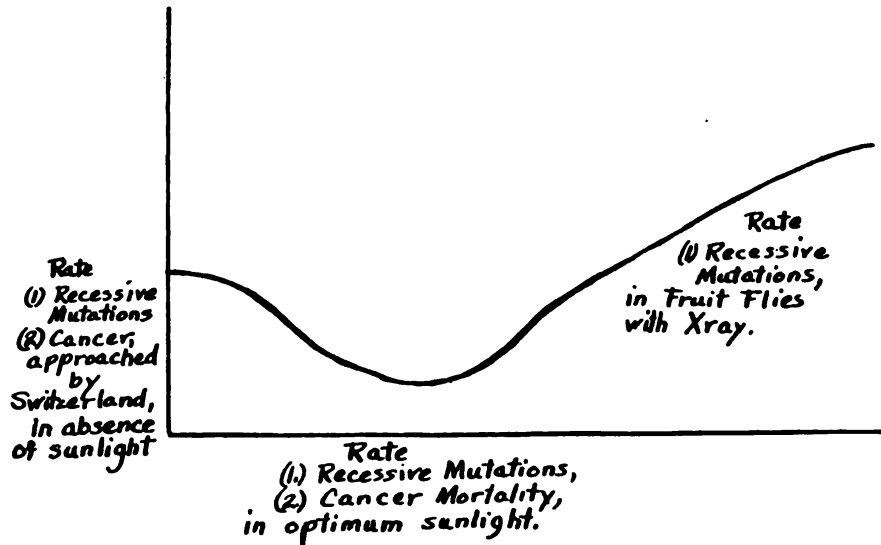


DIAGRAM 4

Finally, if both experiments be positive and this explanation of how cancer arises be correct, an extremely important conclusion is possible. If, in the second experiment, groups of flies are exposed to successively diminishing amounts of X ray so that smaller percentages of them die, and it is found that the actual or relative incidence of *dominant* mutations is *increased*, then it would appear that the following curve might be drawn:

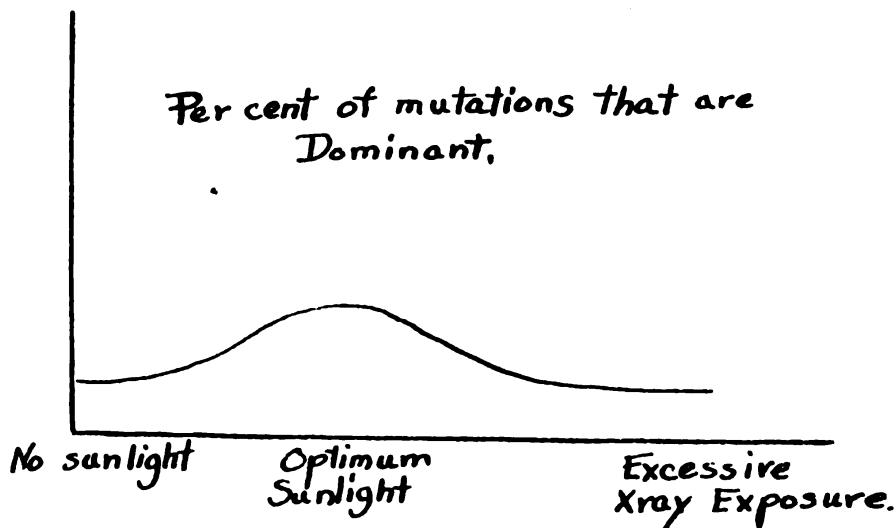


DIAGRAM 5

When it is considered that feeble-mindedness has been found to be inherited as a recessive characteristic the possibilities are incalculable in exposing the human race to the optimum conditions for the occurrence of *dominant* mutations, in germ cells *without* the occurrence of recessives in adults, which would determine higher faculties of the mind than now exist.

For it appears that dominant mutations must be more or less constructive in character since they *usually* predetermine positive characteristics in the adult, like pigment in body or eye, or normal mentality in man, and recessive mutations must be regressive in character since they *are* recessive, and predetermine absence of characteristics. Therefore it is not at all inconceivable that a certain amount of evolution may have taken place by reason of the fact that in very slowly changing or "normal" environment germ cell chromosomes tend slowly to develop, forming dominant mutations of various degrees, predetermining new characteristics in the adult, some of which may prove to make the organism better adapted to the fairly constant environment; and, on the other hand, in suddenly changed environment, with respect especially to ultra-violet ray, normal chromosome development and operation is seriously disturbed, with much recessive mutation, rearrangement, etc., as indicated in Professor Muller's work (and with only a minor amount of dominant mutation, probably the result of regrouping of chromosome material), resulting in *loss* of adult characteristics.

In conclusion, attention is called to the fact that increased exposure to sunlight is advanced only as a probable means of reducing susceptibility to cancer or any neoplasm, and it is not thought that it would be in the slightest degree effective in bringing about any effect on a neoplasm once it has developed. Also, the possibility of lack of sunlight being an etiological factor was first suggested by the statistics, and confirmation of this possibility was sought in the studies made on experimental animals, but it was thought best to present the data in this order for the sake of clarity. For the experimental data only indicates reduction of rate of mutation when excessive X-ray exposures are reduced; the clinical data only indicates that there is probably an optimum exposure; and the statistical data only suggests that we are not getting enough of it. It is felt also that, even if the explanation of the way cancer arises be insufficient in details, there is still enough suggested by the statistics to merit serious investigation and experimentation with sunlight as a means of reducing cancer susceptibility in man or experimental animals not already hereditarily predisposed.

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## LEPROSY IN THE VIRGIN ISLANDS

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Just how long leprosy has been endemic in the Virgin Islands must remain a matter of conjecture.

The chronicles left by Columbus and the early Spanish visitors and settlers do not mention leprosy or any leprosylike conditions as existing among the Carib Indians who inhabited these islands, and it seems reasonable to suppose that had leprosy existed some description suggesting it would have been made. In further support of the belief that it is not a heritage left by the Caribs should be mentioned the fact that these natives had been entirely removed from the islands by the latter part of the sixteenth century.

Charles V of Spain ordered them driven out or exterminated in 1550, and in 1596 the Earl of Cumberland, stopping in the Virgin Islands on his way to attack Porto Rico, found no inhabitants there. Du Tertre, in his history of St. Croix, states that the Virgin Islands were still uninhabited as late as the beginning of the seventeenth century, and Bryan Edwards, in his history of the West Indies, records the arrival of the Dutch and English as occurring in 1625.

By 1645 the inhabitants numbered about 600, but in 1650 these were destroyed by the Spanish from Porto Rico. By 1700 the population numbered some 200 whites and 600 slaves, the islands then being under the control of the Knights of Malta, to whom they had been transferred by Louis XIV. In 1720 St. Croix was again uninhabited, and in 1733 the Danes, who then arrived following their purchase, found it thickly overgrown with bush.

Slave importation existed in St. Croix from 1734 to 1803, and while some leprosy may have been thus introduced it may also have been introduced in large part through immigration to St. Croix from the other West Indian Islands.



It appears that the disease was a social and economic problem in the Windward Islands before becoming so manifest in the Virgin Islands. Carrying the stigma which has always been associated with leprosy, it is possible that leper fugitives sought out St. Croix. St. Croix offered better isolation and agricultural opportunities than could be found on St. Thomas. Furthermore, the rigid quarantine laws which were in force in St. Thomas were not then operating in St. Croix.

In 1873 there was a large importation of labor to St. Croix from the other West Indian Islands. This labor included Chinese and Hindus as well as negroes. Although the laborers were examined upon their arrival at Christianstadt and Frederickstadt, incipient cases of leprosy could very easily have escaped notice at that time.

Some time between 1878 and 1884 leprosy was observed in sufficient number of instances in the Virgin Islands to excite comment, and interest in this disease as a problem was awakened. To appreciate the developments from this awakening, the status of leprosy at that time must be recalled. Although Hansen, in 1871, had isolated the organism of leprosy and fully reported upon it in 1874, and the results of Neisser's study were made public in 1879, the idea of leprosy being an infectious disease with need of isolation did not prevail for several years. Numa Rat in his paper, *Leprosy in St. Kitts*, read in 1896 before the International Congress of Dermatology in London, showed that there was still much doubt at that time concerning the etiological factor of leprosy. The professional and lay press of England and the United States were publishing much on the subject in the eighties, probably as a result of the work of Hansen and Neisser, and it would appear that the interest aroused in the Virgin Islands was a part of a general awakening to the leprosy problem that was being manifested throughout the world.

The native attitude toward the disease is not difficult to explain. While leprosy has always been held in dread as a loathsome disease in any country, the low contagion potentialities which we still concede to it to-day and the long periods of time which may elapse before the appearance of the lesion after a known contact helped to develop and keep alive the disbelief of the infectious nature of the disease. Furthermore, like syphilis, the lesion first noted by the individual may so differ from anything observed in persons with whom he has had contact that he would fail to associate his condition with exposure to others with the same disease. The idea of leprosy being a curse for the sinner had its great and evil effect among these people just as it has served to hinder progress against this disease in any land where it has ever existed.

With poor hygienic conditions existing throughout the island, many in a poor state of nutrition, body resistance low from the usual diseases of that latitude (intestinal parasites, malaria, pellagra, schistosomiasis, tuberculosis, syphilis), in the presence of infectious lepers the increase and dissemination of leprosy was inevitable.

In 1884 St. Croix established a health commission to deal with leprosy in particular. The scope of this commission was later broadened to meet similar problems, but its origin was the need for leprosy investigation and control. A similar activity was organized in St. Thomas in 1903. In 1885 the Colonial Council of St. Croix voted a useful but never strictly enforced health ordinance for Christianstadt and Frederickstadt called for the isolation of lepers in a manner satisfactory to the health commission. The lepers were to be placed in a special sick house and cared for at government expense.

In 1888 the sick house was opened and received 13 lepers. Within one month 5 more were admitted and at the end of the year 11 more, making a total of 29 for the year. Doctor Ehlers estimates that from 1888 to 1903 about one-fifth of the known cases of leprosy were in the sick house.

As to the effectiveness of this isolation measure, certainly it was far from perfect. Doctor Ehlers says that it must have done some good because the cases incarcerated were probably the most contagious ones. However, in discussing the conditions of that time with old employees, it was brought out that there was practically no isolation. The sick house was a place for the inmates to live, but there was frequent communication with outsiders, and the inmates even left at times to work in the fields when they felt the need of a little money or a change of scenes. On Saturday nights they all went to town to rum shops and enjoyed themselves, and, as well as I can learn, these Saturday excursions were with the consent of the overseer in charge. This statement has been doubted by an inspector who came to the island in 1906, but I have received this information from so many of the old timers that I can not disregard it.

The conditions as described above continued to exist until 1898, when Doctor Heyne became the medical officer in attendance. He objected to the raising of vegetables by the lepers for public sale and through his orders the lines were tightened and the isolation made more actual.

During the 16-year period from 1888 to 1903 the Richmond sick house received 127 lepers. By the end of 1903, 73 of these had died, 15 had left the island, and 5 had left the institution for other reasons. There were 34 then remaining. In 1896 Doctor Mortenson found 20 cases in St. Thomas. Of these, 5 were white, 5 black, and 10 mulattoes of various shades. In a survey made by Doctor Kalmar

in St. Croix in 1896, 82 cases were found. He noted a mixed type as well as the nodular and anesthetic types.

Professor Ehlers, who, in 1902-03, had made a leper survey in Iceland and launched the campaign against the disease in that country, came to the Virgin Islands in 1904 and, after studying the situation, reported the following figures:

Location	Men		Women		Total
	Nodular	Anesthetic	Nodular	Anesthetic	
St. Croix.....	11	36	6	33	86
St. Thomas.....	2	2	6	9	19
St. John.....				1	1

Doctor Ehlers recommended that measures be taken to control the spread of the disease, measures similar to those he had introduced in Iceland. More stringent legislation was suggested, and more complete as well as more comfortable isolation and care was advised. The outstanding recommendation was the building of a permanent and more satisfactory leprosarium on the island of St. Croix in which to isolate and comfortably house the lepers of the Danish West Indies. The situation was carefully explained to the colonial body. Reports of leper incidence in the neighboring islands of English, French, Dutch, and old Spanish possessions were brought to attention to show the great scope of the problem at hand. A map including St. Croix was made to show the geographical spread. For some reason his plea met with stubborn opposition on the part of the colonial government, and he returned to Denmark, where he interested the Danish Order of Odd Fellows in his West Indian project. Two years later that organization completed an agreement with the local authorities on St. Croix which allowed the lodge to sponsor the erection of a leprosarium on St. Croix.

Late in 1907, when the leper colony for St. Croix was assured, Doctor Kalmar began the work of locating the lepers in their respective villages and houses, isolating them as best he could in their own homes to await removal to the new leper colony. In 1908 Doctor Ehlers returned to St. Croix and, with Doctor Kalmar, was authorized by Colonial Council to choose a suitable place for the erection of the colony. Their selection was the extreme northeast corner of the Richmond Reservation, the present site of the colony.

In January, 1910, the leper colony of St. Croix was opened for the admission of patients. The cost of construction paid by the Danish Order of Odd Fellows was \$15,000. The colonial government of St. Croix had given the land. The corner stone was laid by the governor and Mrs. Limpinicht with fitting ceremonies.

The census of the new leper colony at the time of opening in 1910 was 61 from St. Croix and 8 from St. Thomas. Below is a census table for known lepers from 1900 to 1924. It is seen that the number was doubled from 1909 to 1910, but this was due to the careful search made at the time of the opening of the leper colony and not to any particular factor of increase.

Year	St. Croix	St. Thomas	Total	Year	St. Croix	St. Thomas	Total
1900.....	24	5	29	1906.....	32	4	36
1901.....	28	4	32	1907.....	34	4	38
1902.....	32	5	37	1908.....	30	4	34
1903.....	36	7	43	1909.....	20	4	24
1904.....	35	6	41	1910.....	61	8	69
1905.....	38	6	44	1911.....	60	8	68

Patients now in the colony who were among those early cases of 1910 state that no attempt to cure the disease was made. Anti-septic solutions for the care and cleansing of ulcers were used and medicines for the alleviation of pain were given. Great attention was paid to cleanliness of person and surroundings. Good food and compulsory rest periods worked wonders in the greater majority of those who on admission were half starved and fatigued and whose resistance was low. To-day, even with a promising drug, we know that absolute cleanliness and good supportive treatment are indispensable factors in the treatment of the disease.

The greatest accomplishment in these early days of the colony was the more complete isolation of the known cases and the interest in the disease which the very presence of a leper colony was bound to instill. In Jamaica segregation has been well enforced and the incidence has been decreased to less than half its rate of 30 years ago. By contrast, in Trinidad, where isolation measures were inefficiently carried out, a steady increase incidence rate was noted. Norway, Sweden, Iceland, Cyprus, and British Guiana are further examples of the value of segregation.

Under the terms of the transfer of the islands to the United States in 1917, the existing contracts between responsible individuals, municipalities, corporations, and organizations having the legal right to acquire, hold, and dispose of properties were to be respected and protected. This includes the recognition of the validity of the terms in the deed of gift of the leper colony as a contract between the Danish Order of Odd Fellows and the municipality of St. Croix. The stipulations contained therein have continued to be observed as far as practicable to the present.

A few months after the transfer Doctor Brockman, United States Navy, was placed in charge of the leper colony. At that time the

medical activities on St. Croix had not been centralized and Doctor Brockman was the administrative officer as well as medical officer to the leper colony. Also, he was in charge of the insane asylum and the sore-leg hospital connected with that institution. His difficulties and problems were countless and, from correspondence still at hand and from talks with old patients and helpers who served him, he undoubtedly handled them in commendable fashion. He changed the colony from a lazaretto to the status of a hospital for the treatment of lepers. He experimented with chaulmoogra oil as a curative treatment for the disease and opened correspondence with the Board of Health in Hawaii which resulted in the acquiring of great quantities of chaulmoogra oil. It may be added that our source of this drug remains the same to-day.

Doctor Oliphant, in 1920, began the treatment on a large and routine scale and another milestone was passed in the progress of the scheme for the combatting of leprosy in the Virgin Islands.

From 1920 to 1922 there were frequent changes of medical officers at the colony. Each medical officer doing duty on the island had his short tour at the colony and then passed on. Some drew the duty a second time in the rotation. The leprosy duty became a part-time or an additional duty, and all matters except the actual treatment and inspection of the institution became more and more foreign to the incoming doctor. Certainly the system was wrong. No individual in such a work and under those circumstances could do more than look after the current inmates in the leper colony in a routine fashion. Certainly the leprosy problem was lost sight of and the field considerably narrowed. It is not to be understood that the doctors' interest waned in regard to the problem, but with their other duties claiming their major attention and the time spent in this work being but four to six months no great advance in leprosy control could be expected.

During this period treatment by chaulmoogra oil was continued. For a while the drug was given by mouth; later by injection, and in some groups the combination of both methods of administration was carried out. This period experimentation did bring about the elimination of the capsule method and the adoption of the injection method.

In November, 1922, Doctor Welch took charge. He was particularly interested in leprosy and remained on this service for a year. Many difficulties were ironed out and treatment became more highly systematized. There was a return to the leprosy problem and Welch's personal contact was felt and its good results observed throughout the field.

Doctor Malcolmson took up the work in December, 1923. He remained two years and accomplished much. He appreciated the

great value of high morale among the inmates of the colony. He was profoundly interested in the lepers, not only clinically but sociologically. He was interested in their little daily problems about the colony; he learned their family relations and brought happiness to many of them through his thorough understanding of their racial characteristics. He devoted much time to inspiring them with varied interests. Entertainments, vaudeville shows, and musicals were encouraged among them and some very good talent was developed. A moving-picture machine was installed and, by giving entertainments, the lepers acquired a neat amusement fund. A stage was built just inside the restricted area and the invited audience could watch the performance from the noncontact area on the outside. The money was received after the shows in the form of donations.

As a result of Malcolmson's trials of different drug combinations, a mixture was adopted which consisted of 3 parts of chaulmoogra oil and 1 part of a 10 per cent solution of thymol in cod-liver oil. To-day the more soluble ethyl esters are used.

During Malcolmson's time the effects of treatment manifested themselves to such an extent that the parole question became a frequent issue.

However, there was no reliable system for the continuance of contact with parole cases, and, once they left the colony, reliable check upon their condition, whereabouts, and contacts could not be assured. Therefore, paroles were necessarily limited.

The trend was such that the leper colony was becoming the leprosy of the Virgin Islands; the administration of the leper colony was becoming the leprosy problem of the Virgin Islands.

The following table gives the essential figures for the colony from 1924 to 1927.

	Census	Admitted from St. Croix	Admitted from St. Thomas	Admitted during year	Paroled during year	Died during year
January, 1924.....	75	68	7	3	1	6
January, 1925.....	72	65	7	10	0	2
January, 1926.....	80	74	6	5	2	5
January, 1927.....	79	73	6	11	3	5

Taking account of a few known cases now outside the colony, it may be said definitely that the present leper population in the Virgin Islands is approximately 90. Based on the general census of 1917, which gave a population of 26,051, the present leper census would be 3.45 per thousand of population. The daily census of the colony has for some years been just about equal to the total census of the three municipal hospitals at St. Croix and St. Thomas.

It is well known that leprosy may exist in a locality without necessarily constituting a focus for dissemination. Practically all civilized countries have their imported lepers, but in only a few of these countries is the disease known to spread. In the United States there have been two main foci of the disease—one in Minnesota and one in Louisiana. The northwest focus shows a tendency to spread. There are always cases of leprosy in New York City, but, according to McCoy, there is no authenticated case where the disease was contracted locally. Thus there is a difference between an area where leprosy exists and where leprosy tends to spread. In the Virgin Islands leprosy was for a long time of the imported class only, but the present number of native Crucian lepers, the increasing prevalence of the disease in natives who have never been off the Island of St. Croix, and the increase in the number of very young native lepers all tend to show that this area is one in which the disease tends to spread.

This is not surprising when it is recalled that leprologists have long agreed that a warm climate, with a low standard of living, in the presence of certain infestations and infections which lower the resistance of the people, favors the spread of leprosy. The high humidity which many workers have emphasized as being a great predisposing factor for the spread of the disease is not present in these islands.

We are dealing with an area in which leprosy is already present in an appreciable extent, an area in which people live under poor hygienic conditions, the community as a whole of poor vitality, ridden with focal infection, worm infestations, and many chronic devitalizing diseases, and for the most part subsisting upon a diet markedly deficient in quantity and quality.

To further accentuate the importance of leprosy as a problem in the Virgin Islands, a problem of wider interest than one to be considered by the islands alone is the increasing contact of these islands with the outside world. Following the American purchase of the islands, with the resulting facility for the Virgin Island citizens to enter the United States, an emigration began and still continues. It seems that the sole ambition of the Virgin Islander is to get together enough money to enter the port of New York. This means an increased health hazard. On several occasions lepers have been taken from ships en route to New York, and it is not uncommon to learn from many of our late cases admitted to the colony that the majority of their contacts are no longer on the island.

Porto Rican relations with St. Croix have greatly increased in the past few years. More ships are touching St. Croix. Contact with the other islands of the West Indies is on the increase. There

is every reason to believe that this greater contact will continue in all directions.

Since the leper colony constitutes the greater phase of our efforts against the disease, a description of the colony, its inmates, and a few statistics and notes regarding the intracolony leprosy and life within the colony are given.

The colony is located in the extreme northeast corner of the Richmond estate, on the eastern shore of the island of St. Croix, just outside the limits of the town of Christiansted. Looking down upon it from the near-by hills, it appears as a pretty village nestled among the green of the banana groves and fields of tall guinea grass, the brightly colored buildings vieing with the vivid scarlet of the bougenvillea bushes. A broad shaded beach provides pleasant siesta throughout the warmer summer days; also bathing, fishing, and the sailing of the little native fungi boats. An open field separates the reservation from the lands of the central sugar factory. This factory is no longer in operation, and this is a great relief to the colony, for during the grinding season the flies at the colony would become unbearable. A small and seldom used road marks the boundary on the inland side. This location is ideal in that it is far enough from town and in a sufficiently isolated area. At the same time it is near enough to the remaining medical activities and is near enough to town to allow the employees to travel back and forth daily.

The outlying fields of the reservation are under cultivation by the lepers. The beach land is covered with banana, cassava, and some papaya trees. The field to leeward is occupied by the fowl houses and the pig run and stables for the colony mules and donkeys. In the midst of this field and beach area is the village itself. The living quarters are concrete pavilions of three rooms each, each room of the pavilion opening on to the breezy eastern side by way of a common covered porch. The rooms are large enough to accommodate three patients. They are furnished with three beds, dressers, table, and chairs. In most instances the patients have added to these articles with their own belongings, some having curtains, pictures, fancy chairs, and the like.

The males are separated from the females by a wire fence running through the center of the compound, and the big gates between these sections are closed and locked at sundown.

Running through the center of the village is the long pavilion which serves for the hospital, treatment room, and the dispensary. In the lower yard near the beach road is the paint locker, carpenter shop, morgue, and blacksmith shop.

In the upper yard is a large laundry and the mess halls.



In the entrance yard and outside the contact area are the quarters for the native resident nurse, the doctor's office, and the general storerooms.

For the patients to be comfortable and for the maintenance of good morale a certain amount of utility room is essential in an institution of this kind. It is not always possible to keep the rooms occupied up to their capacity of three, since patients should be housed according to the stage of their disease. It is not always pleasant nor to the best advantage to house a young comparatively healthy adult leper in the same room with those in the ulcerative and acutely reacting stages of the disease. Furthermore, it is not always well to house the cases three in a room dogmatically, for we meet psychological incompatibilities among these people the same as elsewhere.

The water system of the colony is from a well with a windmill pump which pumps the water into a gravity tank. This water is used entirely for flushing and cleaning purposes. The system is poor. The water is highly corrosive and soon eats away the pipes and shower heads and the cost of repair and upkeep is high. For drinking and cooking purposes rain water from two small cisterns is used. The cisterns are too small to meet the needs of the colony. The writer experienced two long droughts on the island when for many months the colony was on a water ration and it was necessary to haul water from long distances.

The colony is lighted throughout by electricity supplied from the near-by town.

The personnel consists of 1 naval medical officer, 1 graduate supervising native nurse, 2 cooks, 1 janitor, 1 janitress, 1 night watchman, and 1 messenger. In addition to these must be considered the superintendent in the office of the chief municipal physician and one clerk who serves as the commissary steward at the insane asylum as well as the leper colony.

The medical officer is a part-time man and is in direct charge of the colony. He supervises the treatment and is responsible for the discipline and for the upkeep of the property at the colony.

The native supervising nurse is a graduate of the nursing school of the Christiansted Hospital. The advantages of a native nurse in this capacity are manifold. She is housed on the reservation in suitable quarters just outside the restricted area and her residence there has a good effect upon the inmates. Naturally we learn much by association with these people, but we can never reach the high degree of accuracy in interpreting them that the native who already knows them can reach.

The colony has been most fortunate in the past few years in having a most capable supervising nurse and she has contributed much to the smooth running of the institution.

A survey of our patients in 1926 showed that out of a total of 78, 24 were foreign born, 11 were born in the Virgin Islands but had one foreign parent, 7 were native born but had two foreign parents, 5 were native born but could give no information concerning their parents.

During 1927 nine cases were admitted, four of which were of foreign birth or had foreign parents.

A review of the records at that time showed:

Number of charts received.....	109	Native born and of native par-	
Number of foreign born.....	35	ents.....	36
Native born with one foreign par-		Native born with parents un-	
ent.....	13	known.....	18
Native born with two foreign par-			
ents.....	7		

The relative frequency of the birthplaces of the foreign born:

Barbadoes .....	12	St. Kitts.....	5
Nevis.....	9	Dominica .....	1
Antigua .....	7	Guadeloupe .....	1

The relative frequency of the birthplaces of the one foreign parent:

Barbadoes .....	4	St. Lucia .....	1
Antigua .....	2	England .....	1
St. Kitts .....	1	Denmark .....	1
St. Martins .....	1	Ireland.....	1
Tortola.....	1		

The relative frequency of the birthplaces of the two foreign parents:

Barbadoes:		Tortola:	
Barbadoes .....	3	St. Martin.....	1
Mount Serrat .....	1	Antigua:	
St. Kitts.....	1	Antigua.....	1

This nativity aspect is interesting and important. It was mentioned early in this paper in the historical section dealing with the probable sources of our Virgin Island leprosy. The figures are very suggestive. Equal if not more importance lies in the statistics dealing with the nativity of the parents, in view of the highly susceptible period of infancy and childhood. The contact of the first few years of life is extremely important and has emphasized itself upon workers in leprosy.

Most admissions are from the rural districts, although occasionally a town case is found.

As to sex, the females predominate, and as far back as we have statistics in these islands this predominance of females has always existed. Throughout the world statistics show a predominance of

males among the lepers. This would indicate that there is some factor operating in the Virgin Islands which allows us to locate or diagnose the disease more often in females.

That we are locating and diagnosing the disease more often in females with greater ease and less effort is possible. Most of our leprosy has been found recently as a result of patients passing through the municipal hospitals for various complaints. We do know that more females come under our observation per year than males, for not only are they admitted with the usual illnesses but many come in to have their babies, many maintain a contact with the hospitals for the care of their babies, and even the half-grown children are brought in by mothers rather than by the fathers and brothers. Women are also more concerned over disfiguring marks and seek advice. Girl children are brought in for such conditions when little or no attention would be paid to the same mark in the male children. Women are sent into the hospitals by the men to seek advice and treatment when they themselves would not come. Women seek the advice of their preachers more often than men and find their way to the hospitals through that source. Women house servants are sent to the hospital by their employers very often for observation and treatment, and many women come to the dispensaries for examination prior to being employed to get a clean bill of health. When women are found suffering from leprosy they will often name women contacts, but it is more difficult to get their male contacts.

It has not been my experience that the women have the disease in a more noticeable form, thus attracting earlier attention. The women are as well nourished as the men and their general health seems just as good.

The preponderance of male lepers throughout the world is often stated to be due to the greater contacts of men. This is hardly true, because in many endemic leprous countries, as in the Virgin Islands, the women work in the fields just as the men, work in the factories, eat the same food, live the same life, and, if anything, have more contacts than the men.

The fact that our admissions for leprosy are greater among women shows that there are probably many male cases we are not reaching if we accept the fact that in general throughout the leper world the predominance of males is about 2 to 1. In investigating the family histories of the present inmates it is brought out that the families are very scattered, particularly the male members. Some have sought other islands of the West Indies, some have gone to Europe, some to the United States.

The following table shows the ages, varying between the oldest of 78 years and the youngest of 12 years:

Number	Year of birth	Admitted	Number	Year of birth	Admitted	Number	Year of birth	Admitted
1.....	1915	1922	1.....	1902	1917	3.....	1883	1910
1.....	1914	1921	1.....	1901	1915	1.....	1880	1917
1.....	1913	1927	1.....	1901	1925	1.....	1877	1922
1.....	1912	1925	1.....	1900	1921	1.....	1877	1924
1.....	1911	1924	1.....	1899	1919	1.....	1876	1922
2.....	1910	1925	1.....	1899	1920	1.....	1876	1923
1.....	1909	1925	1.....	1899	1922	2.....	1876	1925
1.....	1909	1927	1.....	1898	1921	1.....	1875	1897
1.....	1908	1903	1.....	1894	1915	1.....	1875	1903
1.....	1908	1918	1.....	1893	1922	1.....	1875	1910
1.....	1908	1927	1.....	1893	1927	2.....	1873	1927
1.....	1907	1919	1.....	1892	1922	1.....	1871	1925
1.....	1907	1921	3.....	1891	1910	1.....	1871	1910
1.....	1906	1918	1.....	1890	1910	1.....	1870	1910
1.....	1906	1919	1.....	1889	1918	1.....	1869	1922
1.....	1906	1923	1.....	1889	1921	1.....	1869	1918
1.....	1905	1921	1.....	1888	1918	1.....	1865	1904
1.....	1905	1922	1.....	1888	1927	1.....	1864	1921
1.....	1904	1915	1.....	1887	1926	1.....	1863	1910
1.....	1904	1925	1.....	1885	1901	1.....	1860	1900
1.....	1904	1927	2.....	1885	1910	1.....	1858	1927
1.....	1903	1915	1.....	1885	1918	1.....	1850	1910
1.....	1903	1917	1.....	1884	1914	1.....	1849	1923
1.....	1903	1921	2.....	1884	1919			
1.....	1902	1910	1.....	1884	1921			

Blood relations in the colony at present are as follows: One father and son; one mother and son; one pair of brothers; no cases of husband and wife.

For the maintenance of the morale and as an occupational therapeutic measure, all those in the colony able to perform some kind of work are employed within the colony. From the roll of July, 1928, it is noted that there were 22 women working regularly in the common laundry, 3 were nurses, and 5 were full-time seamstresses. Among the men, 3 were listed as carpenters, 10 gardeners, 1 dining-room assistant, 1 shoemaker, 1 mason, 1 plumber, 1 school-teacher, 4 fishermen, 2 cartmen, 2 swineherds, and 1 male nurse. Others work occasionally in the fields or at the other occupations when work is plentiful for short periods.

There is a definite plan of crops; they produce yams, pigeon peas, and beans. Individual plots of tomatoes, pineapples, and peppers have been grown. There are bananas and papaya to be picked. Cassava is raised, from which the women make starch for laundry use.

This produce is fed to the patients and is of material value in the maintenance of a balanced ration.

The inmates are paid for these services within the colony; that is, they are credited with what they earn and are given credit slips. The money is kept on deposit for their use as they desire it. This intracolony system is checked each month and a statement published on a bulletin board.

This system was established by the Danes. It maintains a certain self-respect among the inmates, is a great thing for the morale in general, and, while the actual amount of money is ridiculously small, it is astonishing how much that bank account means to these people.

Besides the little money they earn the patients receive a few pennies each month as good-conduct money. There is no disciplinary measure which works so effectively with these people. This was also an institution of the Danes and is one of those policies which we have continued in accordance with the treaty.

Aside from the fact that it is a leper colony, the general health, from the standpoint of intercurrent disabling disease, must be called good.

The outbreaks of dysentery which become noticeable in the wet spells following the droughts, increasing the loads in the municipal hospitals, do not occur in the leper colony. There is an occasional case, but not as noted in the native villages throughout the island. A visit to any of the native villages will reveal many nasty leg ulcers, legs of elephantiasis, many cases of pellagra, hobbling tabetics, blind and near blind, leaving a far worse impression than a trip through the leper colony. It is not to be inferred that there are not repulsive cases of leprosy in the institution. But these are in such a minority and there is such a lack of the other miserable diseases that the contrast between the colony and other native villages presents itself to the visitor immediately, and it has often been commented upon.

Complete adjustment to environment is a rarity anywhere, and can hardly be expected in a leper colony. The greatest maladjustments are found where the basic instincts are inhibited by colony regulations. For economic and clinical reasons it is our duty to limit as far as possible the bearing of children among our lepers. If the child remains in the leper environment it is most probable that it will develop the disease. If removed at once and taken by other members of the family we are placing the child in an environment which is still under suspicion, in most instances, as a contact area.

Eight babies were born in the colony in the past 10 years. Not a bad record at all when you consider the great number of active virile men and women in the colony. I have often witnessed women in the child-bearing period of life fondling doll babies, putting them to bed at night, making clothes for them, admitting readily that they would have babies if it would not be a tragedy. Leprosy frequently invades the testicle and ovary and sterility, either in part or complete, results. This can take place and does take place in those of

virile age without the pathology making the patient repulsive or impotent and without appreciably lessening the sexual desire.

Amusement for the leper is not lacking. On holidays they play cricket. They have their own fungi band, and several are very good performers with the violin and accordion. Also there are many good guitar and mandolin players. A new organ was recently given to the patients. Another small organ is also at their disposal. One of the most impressive things I have ever heard or seen was at a colony vaudeville performance, when a tall, very black, imposing native, with the deepest bass voice I have ever heard, recited Vaschel Lindsay's Congo, accompanied by four native drummers. By dim firelight he spoke, enacted, and for those few moments lived that entire poem. His gestures, intonations, and poise were not learned; they were natural expressions.

Most of the patients read, and those who can not are read to by their more fortunate friends. Magazines and books are provided, and the Bible is heartily devoured. On the last Fourth of July I spent in St. Croix we held a field day at the colony, and the program would have done justice to any school. There were fungi sailboat races, dashes, hurdles, broad and high jumps, novelty races, and popularity contests. The women as well as the men took part. Appropriate prizes were given in all contests. For those who could not take part owing to age or infirmity seats were provided and a prize wheel was operated that they might gain a prize.

The cases as observed in the colony present as (1) the essentially neural type with some systemic signs, (2) the essentially systemic type with marked skin involvement and minimal neural signs. These cases have been admitted in the past as a distinctly neural or nodular type, but a survey of their records gives every evidence that in the vast majority of cases they were already of the mixed variety or stage even at the time of admission. All admissions during the writer's tour of duty were distinctly of the mixed variety, with the marked systemic signs predominating. This is of interest from the standpoint of epidemiology. This type which has predominated in the admissions during the past three years is the type common to communities of greater susceptibility. It is the more acute type. In communities where the disease has existed for a long time the neural type tends to become more conspicuous. The conclusion to be drawn from this is that the community is not acquiring an immunity to the disease in spite of its long existence in the island.

There is no distinction made in the Virgin Islands between those cases which are showing the organism and those which exhibit clinical evidence but are bacteriologically free by the usual tests.

These are important considerations. The old ex-lepers do not necessarily require maintenance in a leprasarium. There are many old burnt-out, crippled, and deformed men and women who no longer constitute a menace and could be cared for at the poor farm. Others have people in the islands who could support them and would be required to do so under the present existing law in the Virgin Islands when we have declared them as ex-lepers. This is not a new or radical departure from the accepted standards in the handling of lepers. It is done in other areas where experience with this problem exceeds ours by many generations. It would only be bringing our administration up to date. Furthermore, in Culion, only the cases showing the organism can be segregated by law. Those showing the clinical signs but not showing the organism can be made to take treatment but not segregated.

To revise our leper law would mean the alleviation of congestion in the colony which threatens us more each year as our activities broaden. The burden of expense to an already impoverished community would be lightened and would allow more funds to be applied to the strictly clinical phase of this work, which at present is falling short of its objective.

Tuberculosis is seen as a complication and often as a terminal condition in our lepers. This complication is seen chiefly in males, while nephritis is the more common in females. There are many heart complications to be seen owing to the great amount of focal infection present. In the old cases the most common complaint is the burning sensation in the stomach, with eructations, but unassociated with definite abdominal pain or tenderness.

The increased desire for salt, long recognized as a symptom of the disease, is found among our patients. Their salt ration is increased. It has never appeared that this increased demand for salt varies with type or severity of the disease.

Positive Wassermanns are found among our lepers in about the same proportion that they are found in our general clinical work throughout the island. These checked by Kahns indicate that the positive Wassermann is to be found among them only in the presence of a coexisting syphilis. I have been unable to see that the presence of syphilis alters the leprosy in any way.

Leprologists speak of the peculiar constancy of scabies among lepers. It is rare in our colony and is not seen more often here among the lepers than it is found among nonlepers throughout the island.

With the census at 90, there were 13 definite ulcer cases, about equally divided in type between the trophic and the nodular. Two of them were severe and progressive and resistant to care. The

old-timers in the colony who have learned by experience how much it means to keep their feet in good condition solve their shoe problem by making their own "bile shoes" (from automobile) by shaping a thick section of automobile tire and fitting soft leather thongs to fasten, as in the old Roman sandal. These are particularly good for the deformed types, are very serviceable, and are never worn thin. As an expense they are nil.

Under the head of supplementary care must be included the care of the usual complications of leprosy. The ulcers have been referred to. The most important of these complications is the lepra reaction. The patient develops an acute fever, with exaggerated bone pain, multiplication of or an increase in size of the nodules, some edema of the hands and face, and a general prostration. In some cases, particularly those that have had previous reactions, the onset will be more gradual, the prostration not as severe, and the local lesions may not react so acutely. The nodules may ulcerate and become very tender, with a deeply seated pain under them and not in the skin itself.

The mild cases often require no definite medical treatment, except for catharsis and some alkalization. The more severe and persistent cases require much attention. Our procedure is to put them to bed on a semiliquid diet, with the fluids forced and forced alkalis by mouth. The usual saline purge is given. Coal-tar products are given for the alleviation of the bone pain and seem to work better than drugs of other classes. The oil injections are discontinued during the reaction.

It is usually in the cases with marked involvement of the skin that the severe reactions are seen. For some reason they bear the treatment poorly and the drug should be given with added care and in graded dosage to these cases. It is impressive, however, how some of these cases will improve following one of these reactions. It is also, at times, rather discouraging how they will lose weight and become more miserable in spite of everything done for them.

Local injection of skin lesions by the approved technique were tried, but I never saw any benefit from this procedure.

As to our results with the present treatment, something should be said. We are not yet in a position to offer any statistics of value in regard to the effectiveness of the ethyl esters as used in the Virgin Islands. Our cases have not been classified sufficiently and have not had individual study in sufficient numbers, nor has the treatment been diversified or particularly applied under conditions that would warrant such a report.

Malcolmson grouped a series of cases in the colony which presented similar characteristics and with our present mixture noted



very encouraging results. I endeavored to follow up this same series and was able to add to it from time to time. The drug was not given under ideal conditions, but the response was good and progress very gratifying.

The outstanding features noted were: The cutaneous lesions respond more rapidly and are more spectacular in their retrogression than the anaesthesia. In all of the new cases admitted, with no history of previous treatment, the cutaneous lesions began to reduce in size and change color after two or three injections. The rate of improvement is rapid at first, and then slows up. Anesthetic areas are reduced in size. The general health improves under the treatment and the patient's general attitude is better. In the older, advanced cases, the drug has apparently altered the disease and has been of some benefit. Comparing the group that has taken treatment regularly with those that have taken the treatment irregularly and those that have had no treatment, the first group remains better physically, the second group is somewhat better than the third and seems to retain more bodily vigor and comfort, but a slow progress of the disease is apparent.

There are those who have come in early and taken treatment but have become steadily worse. There are those who have improved by rests from the treatment. There are those who never take treatment, their disease remaining practically stationary.

In the East a leprosy congress has remedied much disconcerted action of workers who were widely separated geographically and by the variance in racial customs of their countries. In spite of the much closer intercourse and proximity of the islands of the Caribbean and neighboring mainlands, and although the health problems of each of these areas have a distinct bearing upon each other, there has not been the close affiliation between them that is necessary for the common betterment. It would be most fitting that the United States take the initiative in establishing a leprosy congress for this latitude. The writer wrote several personal letters to the government physicians in the other islands of the Antilles asking their opinions and desires in this respect and the replies were most encouraging.

For much of the data covering the Danish regimen I am greatly indebted to Dr. L. P. Pontoppidan, of Copenhagen; for the legal references cited I am very thankful to the late Judge A. E. Stakman, of Christianstadt. The incentive to compile these notes has ever been the appreciative and cooperative attitude of the unfortunates themselves, the lepers.

**HAITI'S GREATEST PUBLIC HEALTH PROBLEM**

By K. C. MELHORN, Captain, Medical Corps, United States Navy

The problem is that of overcoming the woeful ignorance, superstition, and apathy with regard to the real meaning and value of health. Because it was not until 1924 that any serious attempt was made to provide rural clinics and rural schools, the country districts, in which the vast majority of 2,000,000 people live and in which yaws, malaria, intestinal parasites, and malnutrition persist, continue to be a serious handicap to the physical and economic health of the nation.

Success in overcoming this state of affairs necessitated two procedures—first, a country-wide attack against disease itself, and, secondly, the establishment of strong lines of support by educational measures. With the modernizing of all the old hospitals, the building of new ones, and the rapid advance of the rural clinic system throughout the country, the first stage of the campaign has been successfully effected. That these units, the first line of defense, have proven their value as an investment, no one can deny. By restoring health and alleviating the suffering of thousands upon thousands, they have not only checked the advance of disease but have played a major rôle in bringing before the people the real meaning and high purpose of the intervention. The people realize as never before that Haiti is experiencing a new birth, a new freedom, and a real hope for the future.

But the splendid advances to date will not be permanent; present lines can not be held without the strong supporting movement of education. By this means a real public health conscience can be awakened throughout the land. People must not only be informed as to the whys and wherefores of health, but they must be educated to intelligently demand it—demand it not only from the National Government but far more so from the respective communes. The National Government can not afford to maintain indefinitely the mounting costs of its hospitals and clinics. Only by education can it be relieved.

A program for general, industrial, or any other type of education in Haiti that does not accord a prominent place to health is doomed to failure. Much is now being accomplished in improving the school situation, and to take advantage of the opportunity presented, this service instituted within the past year its program for the city of Port au Prince detailed in reference (1). To further develop and expand this work, so that the whole country may profit, requires an appropriation apparently not possible heretofore. Be that as it may, in our opinion Haiti can make no wiser investment, for without health there can be no permanency to human endeavor.

In making this recommendation we are not unmindful of the obligation to our 3-year program as formulated and promulgated in 1927. This program deals with the present and dare not be neglected. Especially is this true of the situation in regard to the hospitalization of the insane and isolation of lepers. If the state of the treasury be such that we can not hope for increases over and above these estimates, we shall maintain present lines as best we can.

With a credit that would guarantee for five years an annual allotment of 1,000,000 gourdes (\$200,000) to this service for public health educational work, an intensive national campaign to include the following features could be effected within a very short time. From results already secured in the short period in which our program has been functioning in Port au Prince it is certain the country would never regret the investment. In fact, it is the opinion of this office that no activity in Haiti will be a success or endure for any length of time unless this or a similar movement is effected.

With the above presentation of the subject matter, this office recommends a national program of public health education to include the following features to be effected and controlled by the Public Health Service:

- (1) Medical examination of all school children.
- (2) Special courses for teachers in the national and service technique schools and collaboration with the teachers in parochial schools.
- (3) Special courses for pupils and the supplying of suitable textbooks.
- (4) Establishment of health centers in every sanitary district, such centers to include the services of physicians, dentists, public health nurses, infant welfare, and prenatal clinics.
- (5) The institution of traveling health centers for remote country regions.
- (6) Establishment of a few public health fellowships, the studies to be pursued in countries where Rockefeller Foundation representatives are stationed. By such agents this office can be enormously assisted in the selection of proper locations for study and the supervision of each fellow.
- (7) Systematic publicity work in the press and by means of bulletins published by this service.
- (8) Selection of certain schools and equipping of same for establishment of units to demonstrate the value of balanced diets.

As will be noted in reference (1) the public health education movement now functioning in the district of Port au Prince is but a small part of the program recommended for the entire country. It was instituted last October, and as at present developed is requiring an expenditure of over 8,000 gourdes (\$1,600) a month.

## REFERENCE

- (1) Paragraphs 2 and 4 of page 2, paragraph b of page 4, and pages 13, 14, 15, and 67 to 70 of the Annual Report of the Public Health Service for the fiscal year 1927-28.

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**MEDICAL MYCOLOGY**<sup>1</sup>

By G. W. COOPER, Lieutenant, Medical Corps, United States Navy

**PART I. HISTORICAL, AND PLANT PATHOLOGY**

It is the purpose of these few lectures to give the routine methods of working with fungi and to review the common and certain of the uncommon molds encountered in medical and surgical practice. In pursuing these objectives there will come to you once more the nomenclature and diagnostic perspective of the medical mycologist, both of which you have at one time partially acquired in undergraduate or graduate courses in bacteriology, pathology, or dermatology. The diagnostic perspective is even more important than the nomenclature, especially for medical men of the naval or military services.

Whether you acquire the nomenclature of mycology or not is of secondary importance. The mere words of any nomenclature are much as the treatment chapters in texts of internal medicine, which may be easily read and prescribed, even by most laymen, after the diagnosis is made.

Since you are very often on duty in the Tropics, it is very well to maintain a constant watchfulness for fungous conditions. They appear more commonly in the Tropics.

To become imbued with the diagnostic perspective for medical fungi, one must first acquire an understanding of the diverse problems of general mycology with the plant pathologist and the botanist. If you have sufficient curiosity, you will develop interest in and sympathy with a subject which to most people is a very dry and seemingly useless one.

For example, if the household wash has been collected in a damp state from the wash line and allowed to stand packed in a basket overnight, there is often a resulting "mildew." What is the minute and gross structure of this mildew? Why does it "happen" at certain times and not at others? If these two questions interest you, then you are interested in mycology.

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<sup>1</sup>This is the first of three lectures delivered at the Naval Medical School, Washington, D. C., in November, 1929. The remaining two lectures will appear in forthcoming issues of the Bulletin.

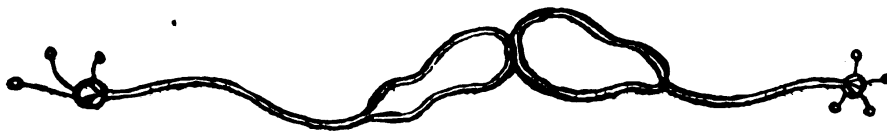


FIGURE 1. The bicelled spore; tapers at both ends and is constricted at the central plane. (Cooke)



FIGURE 2. Spore pedicels breaking through a shaft of straw or cuticle of wheat leaf

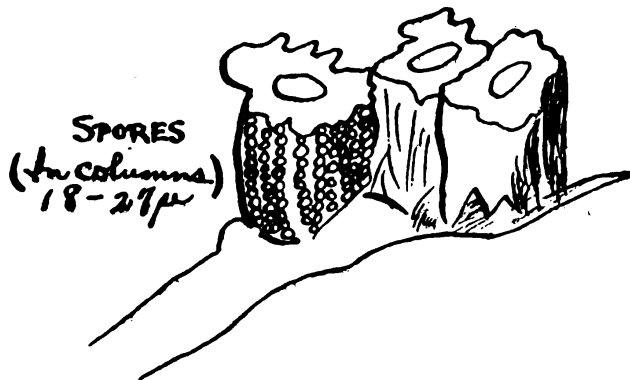


FIGURE 3. (Cooke)

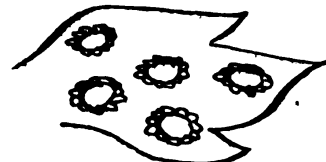


FIGURE 4. (Cooke)

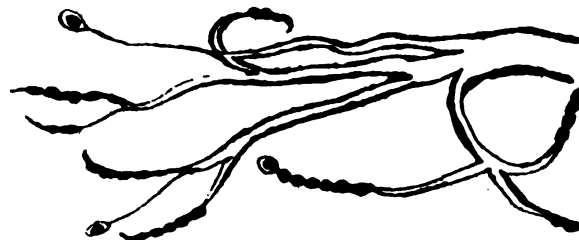


FIGURE 5. (Cooke) Potato Mould Phytophthora



FIGURE 6. (Cooke) Lettuce Mould Bremia

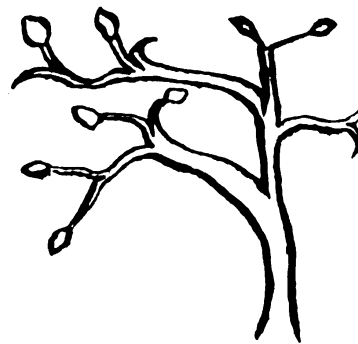


FIGURE 7. (Cooke) Pea Mould Peronospora

First, I wish to refer to a phase of the history of mycology as a science. In this connection you would find it profitable to look at two fine old books—Rust, Smut, Mildew, and Mould, by M. C. Cooke, published in 1872; and Arrangement of British Plants, by William Withering, published in 1818. These books are on the shelves of the Naval Medical School library.

In Withering's book the whole field of fungi was considered, with 564 species listed.

The old genus *Agaricus* included 300, while less than 80 microscopic fungi were recorded as known species. This number grew rapidly to 2,479, enumerated later by Cooke in 1865 in the *Index Fungorum Britannicorum*. The generic and specific characterization of most of these now depended on microscopic appearance. This was a revolutionizing advance, but it was soon to develop that the microscopist alone could not diagnose or classify fungi.

The microscope replaced vague uncertainties with precise knowledge, and for the time being a near approach to rational classification was thus effected.

Perhaps in no other field do vague and ill-defined conceptions prevail more than in mycology. "Mildew" means something different to the individuals of each community. English farmers, as Cooke points out, of the Norfolk country have known it as the irregular brown lines and spots which develop on standing corn. The fungus on wheat straw was thought to cause colic in cattle eating it. This fungus is *Puccinia graminis*. *P. rubigovera* is the other commonly found rust of cereals, or wheat rust. *Puccinia* and *Uromyces* are the two most common genera of the old group *Pucciniaceae* or rust molds. This family is named for Puccini, the Italian anatomist. The rusts on the bean plant are certain species of the genus *Uromyces*.

To the usual family circle, another and more minute species is known as mildew when it attacks damp linen.

The hop grower has his mildew which attacks the hops, the gardener his mildewed vegetables, the vine grower his mildewed vines, the stationer his mildewed paper taken from storage, and the plasterer his mildewed walls. The work on a mildew of the grapevines in France is now considered a classic in mycology and led directly to the work on Bordeaux mixture which saved the vines from the destructive plasmopara.

The word is almost universally used to imply the destructive or useless types of fungi. One of the earlier British etymologists applied the meaning of mildew of grain as the same as the French word "ergot." This occurred in one of the best British dictionaries, but was evidently a mistake, since anyone who has seen the mildew fungi and the ergot fungi could not possibly have confused the two.

The French word "ergot" comes from the Latin "ergota," and is taken to indicate any fungus which attacks and finally replaces the seed of one of the cereal plants. The ergot of rye is the type species and is usually thought of as the most important ergot fungus. This fungus is the *Claviceps purpurea*, the notorious ravager of cattle herds in regions where large rye crops are raised and the fencing of pasture lands is haphazard, as in Russia.

As you all no doubt know or have known, this fungus, *Claviceps purpurea*, is the source of our commercial ergot. The drug is derived from the sclerotium, which is the dense mass of rusting-stage hyphae of certain fungi.

Mildew was formerly known, according to Cooke, as "rust" to the English farmer. The botanical name of one of the commonest rust fungi was formerly *Trichobasis rubigo-vera*. Among others, the generic name Puccinia is now used for rusts but not for mildews. The wheat or rye stalks in May or June, especially the lower leaves, show rusty spots, as if sprinkled with powdered red ocher or cinnamon. They may be withered and dying. A pocket lens shows the cuticle traversed with many longitudinal cracks or fissures, within which is scattered an orange or red powder. The cuticle of the leaf may also be distended into yellowish, elongated pustules, not yet ruptured. These pustules constitute the spring or very early summer stage or red-rust stage of the fungous invasion.

The microscope must be used for further study of the parasite. The "rust" consists of innumerable delicate branched or unbranched threads, anastomosing by lateral branchlets. This is the usual mycelium. A number of very small, transparent, and colorless cellules develop from the mycelium. These enlarge and become filled with an orange-colored mass of spores. These blisters in the cuticle of the leaf now constitute spore spots, which rupture and leave the fissures before mentioned. The spores are arranged on short pedicles and now break free and lie on the leaf as the ocher dust or rust. These spore cells are globose or slightly oval, transparent, and unicellular. This is the so-called "uredo" stage. Immature spores are round and much smaller, while the mature spores are oval.

In July, August, or September the rusty leaves will have become much more common and extensive. Distinctly reddish-brown pustules are now intermixed with the rusty ones. A little of this brown powder under the low-power objective now shows, if examined in a drop of alcohol, a different and variable picture. A few globose, uncellular, yellow spores remain, but most are now oval, having pedicles (if carefully removed from the leaf with them), and are now bicellular or tend to be so. This is a "telial" stage, composed of teleutospores. A septum now divides the original cell trans-

versely into an upper and lower cell, while a constriction in the plane of the septum at the margin is in evidence. These bilocular spores are those of *Puccinia graminis*, or "wheat rust." While very small (35 to 60 microns), they are often so plentiful as to be scooped up by the handful from the binder at harvest time. This rust has formed much the same pustules and mycelium as the other cereal rusts.

When the wheat is nearly or fully ripe the sheaths of the leaves will now show black spots from 1 mm. to 1 inch in length. This is fully developed mildew (in the English meaning of older texts), and once seen is not likely to be forgotten. In America we now consider the mildews to be entirely different genera, such as the *Plasmopara* or downy mildew as found on the grape.

When these tufts of bilobed spores break through a shaft of wheat or rye from the underlying mycelium, they resemble a species of snail if examined with the hand lens.

Minute colorless threads arise both from the upper and lower divisions of these spores and grow to be several times the length of the spores. The ends of these threads swell and are divided by two or three septa and in which an orange-colored endochrome develops. One to four spicules develop on these threads and become rounded on their ends to form sporidia. These fall and germinate in the leaves of the barberry, being spread by the wind. The next stage in the life cycle is on the barberry.

This species is very common on cereals cultivated in England and America and on many grasses. The fungus does distinct harm, and, as it occurs on many grasses, you can see the prudence and logic of keeping all weeds and grass cleaned from the field. The rust mold is said by some to be most common on plants growing on the site of old dunghills or on very rich soil. The cereal rusts and similar parasites were formerly known in some communities of England as mildew. This concept does not obtain in this country. The downy mildews are *Phycomycetes* and the powdery mildews are *Ascomycetes*.

A similar species of rust attacks the water mint, horse-mint, and other types of the mint plant and is known as *Puccinia menthae*.

A similar species of fungus is found on the dandelion and is known as the *Puccinia taraxaci*. The pustules are found on both sides of the leaf and are small and scattered. The variable character of the spores had once given the specific name of *P. variabilis* to this species. The two lobes of the spores may be equal in size, or the upper or lower lobe may be larger, or there are some in which the septum is absent altogether. More rarely there are two septa and three cells to the spore.



The boxleaves, periwinkle, violets, the anemone, thistle, plum tree, bean leaves, primrose, and the half-dead stems of asparagus have one or more distinct species of *Puccinia* as parasites. About 2,000 species of "rusts" are on record.

#### SMUTS

The "smuts" affect the corn, wheat, or rye and other cereals and cause brown or black pustules on the leaves, stems or points of fructification. These spores vary from 5 to 25 microns in the various species and constitute a very fine black or brown powder. The smuts also attack various grasses.

#### CLUSTER CUPS

These are the aecial or aecidium like stage of *Puccinia graminis*. Certain plants, having the *Puccinia* parasite, have also the liberation of fungi spores from cuplike excrescences on their leaves. The anemone, for example, has both the *Puccinia* anemones and a cup-like parasite, which was formerly known as a distinct species, the *Aecidium leucospermum*, or cluster cup.

It was later found that this anemone cluster cup was a separate and distinct stage in the life cycle of the anemone *Puccinia* or rust and that the two fungi, thus far considered of different genera, were actually but phases of the identical organism resident upon the same host. Other species of rust, like the *Puccinia graminis* or wheat rust, require an intermediate host for the development of the cluster-cup stage. As I have pointed out, the wheat rust develops its cluster cups on the barberry. Many species, however, resemble the anemone rust and develop their cluster cups on the same host.

Researches in plant pathology are fast making the genus *Aecidium* an obsolete one, for it is being proven that many of these cluster cups are but an incident in the life history of the *Puccinias* or other genera of rusts. In this manner the anemone cluster cup was taken from the genus *Aecidium*, and its old specific name, *Aecidium leucospermum*, remains now but a confusing specter of the past for the mycologists to worry with in the history of their science. To-morrow our own nomenclature will be discarded and our concepts proven erroneous.

*Aecidium* is still retained, however, as a generic name for that diminishing group of fungi showing cluster-cup excrescences which have not yet been demonstrated to be an intermediate stage in the life cycle of one of the rusts or some other fungous family.

The cluster cup of the goatsbeard (*Tragopogon pratensis*) may be described as the type species. In May or June the leaves or unopened involucre appear as if sprinkled with gold dust, except that

the gold color is without luster. The orange powder issues from the plant itself by hundreds of small orifices or little yellow cups with an outer margin of white teeth; these are thickly scattered over the under surface of the leaves.

These cups are peridia and appear to burst through the epidermis and project above the surfaces of the leaves. (See fig. 3.) Inside these peridia is a mass of orange spherical dust particles, much of this already having been shed and scattered over the leaves and stems as well as upon the blades of grass or bodies of plants growing near by. The cups are fungi and the yellow dust is spores (or rather protospores, in a strict sense, or the spores of the first stage of the life cycle, because they germinate, and upon the mycelium thus formed the true spores develop). The cluster-cup and the rust stages both appear on the identical host in this species of *Puccinia*.

The family of fungi having spores as the main feature has just been illustrated by one of its species and was formerly known as Coniomycetes, from the Greek words meaning dust and fungi. These rusts now belong to the family Uredineae.

In the early days of biologic classification there was constant uncertainty and confusion. At present we have an arrangement into classes, orders, families, tribes, genera, and species as given us by the Bergey committee classification of bacteria in 1923. This, in part at least, is in direct reverse order to the nomenclature of biologic groups as engendered in early texts. Thus, M. C. Cooke, in his *Microscopic Fungi* of 1872, discusses these cluster cups as of the family Coniomycetes, which latter includes several smaller groups or orders. This family is now obsolete. The order Aecidiacei was earlier so called from its largest genus, the *Aecidium*. The cluster cup is common on the barberry plant. This was later found to be the intermediate host stage of *Puccinia graminis*. In this identification of species there is an exact reversal of the categories of family and order as we know them to-day. In reading the older texts, therefore, one must give almost entire disregard to the biologic classifications.

Cluster cups of the older order Aecidiacei (discarded, since the life cycle is known) always develop on living plants, flowers, fruits, or stems, but usually on the ventral surface of the leaves, sometimes on the upper. Various species are found in Europe, North America, Asia, Africa, and Australia, and probably exist in all countries. The identical species may be found on a variety of plants.

These cluster cups also occur on the ventral surfaces of the leaves of the wood anemone (*Anemone nemorosa*), but not nearly so commonly as on the goatsbeard. On the other hand, most every plant

of the anemone will be found covered in the spring months with the brown spots of the other fungus I have described, *Puccinia anemones*.

Various species of violets are also attacked by *Aecidium*, but this species of cluster cup is less common than most of the others. The peridia are scattered over the yellowish spots on the leaves, usually but one spot on each leaf, and found upon the violet plants in the spring and as late as June.

Cluster cups likewise occur on nettles, honeysuckle, and certain fruits, as gooseberry and red currants.

The barberry plant has cluster cups on the under sides of the leaves, which latter are infected by the spores of *Puccinia graminis*, which are the winter spores on the stems of wheat plants. The barberry spores are therefore the summer spores and the barberry is the intermediate host, developing its cluster cups from the *Puccinia* spores of the preceding winter which have survived on the grain stubbles.

Other species of rusts complete their full life cycle upon one plant, which therefore will show both the *Puccinia* or rust spores and the cluster cups, which discharge even smaller spores. Both stages have already been described, but are now known to be distinct phases in the life history of the same parasitic fungus. A plant organism is often necessary as an intermediate host to complete the life cycle of the mold, just as many infective agents of man require the intermediate host for propagation of species.

Early in the history of mycology which we have traced in a necessarily cursory manner, we have seen that the cluster-cup fungi were placed in a separate genus, the *Aecidium*, because they were as yet unrecognized as an incidental stage in the development of *Puccinia* or other rust molds. The life cycles of these and molds showing similar fructification processes have been worked out by the experimental plant pathologist, who, like the bacteriologist, obtains pure cultures of the spores and inoculates them into the cuticle of plants suspected as factors or a factor in the case. This opens a field far beyond the idle speculations of the mere microscopist.

There is also an interesting genus of cluster cup having the cups embedded within the substance of the leaves.

#### MOLDS

Cultivated plants of all kinds and many animals, including man, are more or less subject to the ravages of fungi. Some, such as wheat and the grasses, are more susceptible than others. Likewise, certain animals and individual humans appear more susceptible than others. Most of these parasitic fungi on man are of the so-called imperfect type or of the subclass *Hyphomycetes*. Fuckel's class

designation is Fungi imperfecti. They have been called Fungi imperfecti because the fructification organs characteristic of the other classes are not well defined. Greater difficulties are thus experienced in the classification of this class than others. The word Hyphomycetes is from two Greek words meaning "thread" and "mold." The order is thus designated because the threads of the mycelium are the distinctive feature of the various genera. Many of the molds parasitic on vegetables are Hyphomycetes, but most of them are of the Ascomycetes.

The potato mold is the commonest and most devastating species of the Phycomycetes and is the cause of one form of potato rot throughout England, continental Europe, and North America. Common species are of the genus *Phytophthora*. (See fig. 5.) At times it threatens the entire potato crop, especially in certain regions when the season is very warm with excessive rainfall. Commoner species of lettuce and pea molds are of the genera *Bremia* and *Peronospora*. These potato, lettuce, and pea molds are all of the downy mildews of the class Phycomycetes.

*Potato mold*.—The microscope reveals nodose swellings of the branches with sporangia attached to the tips. These sporangia are true oospores which in early spring rupture, liberating spores (usually about eight) which form a dense, tangled mycelium which attacks the ventral surface of the leaves and kills them. The leaf stem and finally the tuber itself is attacked. This species (*Phytophthora infestans*) is marked by alternate thickening and constriction of the mycelial branches or hyphae, which are also more erect than in allied species. The conidia or asexual spores are solitary on the tips or less often from the sides of the branches (not in pairs or clusters) and the tips are single (not bifid or trifid, as in most other species of the genus). The number of spores, 6 to 16, formed in the spore cases is also distinctive. In the parsnip downy mildew mold, also a Phycomycetes, there are 6 to 14 spores formed. Other allied molds attack the turnip, onion, spinach, the common nettle, and the wood anemone.

#### DOWNY MILDEWS

These are of the class Phycomycetes, formerly considered an order. The potato, lettuce, and pea molds illustrate the commoner species.

These belong to the class Phycomycetes and are very destructive to the common garden vegetables. They are the true mildews of so-called "downy" type, and include such genera as *Bremia*, which contains the lettuce mildew, and the *Peronospora*, which contains the species attacking the pea plant and grapevines. The destruc-

tive grape variety is the *Peronospora viticola*, the study of which in France led to the development of Bordeaux mixture for the treatment of vines for mycotic infections. This work on the *Peronospora* now stands as a classic in mycology, and the *P. viticola* may be regarded as a type species of the downy mildews. Sketches of some common garden varieties are given after the texts of plant pathology.

#### POWDERY MILDEWS

These belong to the class (known as order by former authors) *Ascomycetes*, and upon certain hosts are even more prevalent causes of fungous disease of plants than are the downy mildews. They are common invaders of forest trees, bushes, flowers, and vines. They may also cause a powdery mildew of the garden vegetables, such as the bean and pea plants. The downy mildews, on the other hand, are, in general, more destructive to our plants of economic significance, such as the garden vegetables and grapevines. In certain regions of the United States, as in California, the powdery mildews are reported to flourish well and to be even more devastating for the grape than the downy mildews. Generalizations in comparisons of this sort are difficult to formulate.

It is to be remembered that besides the *Phycomycetes* there are various species of *Ascomycetes* and *Hyphomycetes* that are also the usual destructive parasites of our common garden vegetables.

It is readily seen at this point how the many genera causing so extensive devastation of our cultivated crops are in the same order and resemble, in general respect, the various other genera of *Ascomycetes* and *Hyphomycetes* which cause diseases of man. In fact, certain uncommon forms of mold disease in man are reported by some as contracted by picking up the spores from infected soil or vegetables, viz, *Sporotrichum beurmanni*.

Various genera of the other classes are also extensively distributed in nature, as well as causing disease in man. Alvarez has reported a red *Torula* infection of the tongue of a man. Various species of *Torula* have been isolated from cheese, soil, rat dung, etc. They are the wine yeasts causing fermentation and flavors of wines.

The *oidium* species have been isolated from very rotten wood, damp paper, dust of hospital nurseries, putrefying oranges, pears, apples, plums, and the leaves of various plants. Other species have been shown to cause the thrush of babies' mouths.

(To be continued)

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**THE USE OF HYPERTONIC SOLUTIONS IN THE TREATMENT OF ACUTE INTRACRANIAL HYPERTENSION**

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**INTRODUCTION**

The use of hypertonic solutions in the treatment of acute intracranial hypertension has added another important and valuable procedure to the therapeutic armamentarium of the naval surgeon. The operation of cerebral decompression has been the recognized remedial measure for the relief of increased intracranial pressure and medullary edema, which so often complicates cranial injuries. This operation is a formidable if not an impracticable procedure for a medical officer alone on an isolated ship or station with limited assistance. But now that the physiological effects of hypertonic solutions have become so definitely established, he has at his disposal, applicable to a large percentage of cases of cerebral trauma, a method of treatment which does not involve a complicated technic and utilizes materials which are readily available.

To Weed and McKibbin (1) has been given the credit of first demonstrating, in 1919, that the intravenous injection of a hypertonic solution causes a shrinking of the brain and a fall in the pressure of the cerebrospinal fluid, even to zero. This observation was put to clinical use the same year by Haden (2), who produced symptomatic improvement in a case of cerebrospinal meningitis, which had developed pressure symptoms, by injecting a 40 per cent solution of dextrose. Further clinical investigations were made by Cushing and Foley (3), and the following year Sachs and Belcher (4) made a preliminary report on the advantages of reducing the intracranial pressure during cranial operations by means of the intravenous use of a 35 per cent solution of sodium chloride. Dowman (5) in 1922 and Fay (6) in 1924 advocated the use of hypertonic solutions in cases of acute intracranial hypertension resulting from cerebral traumatism, and during the past few years the medical literature, both here and abroad, has contained many other favorable and enthusiastic reports on the use of these solutions.

The purpose of this paper is to discuss the various solutions used, the physiological basis of their action, the indications and limitations of their use, and their administration.

**SOLUTIONS USED**

Hypertonic solutions of sodium chloride, Ringer's formula, magnesium sulphate, and dextrose are those commonly used at the present time. Each will be discussed separately.

*Sodium chloride*, when introduced into the blood stream, raises the osmotic power of the blood, so that there is a withdrawal of fluid

from the tissue spaces, especially those of the ventricular system, and a reabsorption of part of the cerebrospinal fluid into the blood stream. This action is prompt and causes a shrinkage of the brain and a fall in the intracranial pressure. This effect, however, is followed within one and one-half to two hours by a secondary edema of the tissues and rise of the intracranial pressure, due to the fact that sodium chloride is dializable, and when present in high concentration in the blood passes in variable amounts from the blood stream into the tissue spaces and is retained in them. When the concentration of the sodium chloride in the blood stream is reduced by renal excretion below that temporarily in excess in the tissues, the higher osmotic power of the tissues causes an excessive reabsorption of fluid by them from the blood, resulting in edema. This secondary edema is at times quite marked and is a distinct disadvantage in the use of solutions of sodium chloride in those cases where prolonged treatment for the reduction of pressure and edema is necessary.

Sodium chloride is best given intravenously. For vigorous effect Peet (7) advises as a maximum dose 100 c. c. of a 30 per cent solution. It is usually sufficient, however, to give only 70 to 100 c. c. of a 15 per cent solution. This amount may be repeated every four to six hours. Care is necessary while injecting these solutions that none escapes into the subcutaneous tissues, for necrosis will result. Sachs (4) has shown that there is no increase in the friability of the red blood cells after the use of solutions of these strengths.

This salt has been given by mouth (16 gm. in 2 gm. salol-coated capsules with 80 c. c. of water) and by rectum in hypertonic solution. Given by these routes, its action is somewhat slower and less effective than when used intravenously, and is often followed by distressing gastrointestinal symptoms (pain, vomiting, thirst, etc.). Because sodium chloride is dializable it has a twofold action when given by mouth or rectum. Some passes through the intestinal mucosa by osmosis into the blood stream and raises the osmotic power of the blood, acting in the same way as when given intravenously, while that part remaining in the intestines abstracts fluid locally from the tissues.

A secondary edema follows the use of sodium chloride when given in this manner, just as after its intravenous administration.

*Ringer's solution.*—Although there are no reports of patients having been poisoned by the use of hypertonic sodium-chloride solutions, toxic symptoms and pulmonary edema have occurred in laboratory animals following their use, so that Peet prefers to use a 35 per cent saturated Ringer's formula in place of hypertonic sodium chloride. This solution is given intravenously in the same quanti-

ties as sodium-chloride solutions and is equally effective. But its primary dehydrating action is also followed by a secondary edema similar to that occurring after the injections of hypertonic sodium-chloride solutions. Thus no advantage is gained in this respect by the use of Ringer's formula.

*Magnesium sulphate* is administered by mouth and rectum—never intravenously, because of the danger of a general anesthetic effect and respiratory paralysis. Although its action is not as prompt as that of sodium chloride, Fay (8) considers it more efficacious, and this salt possesses the decided advantage over sodium chloride of not producing a secondary edema of the tissues. As magnesium sulphate is not dializable, it can not pass through the intestinal mucosa into the blood stream unless the mucosa has been severely damaged. It acts by dehydrating the blood in the intestinal capillary network, thus raising the osmotic power of the blood, which then depletes the tissue spaces throughout the body.

Magnesium sulphate is given by mouth in doses of 60 c. c. of the saturated solution repeated every four to six hours until the desired degree of dehydration is obtained. A mild continuous action is obtained by administering 15 to 30 c. c. of the saturated solution every two to three hours (or twice that dose by rectum). One dose of 60 c. c. is sufficient in those cases of mild trauma which complain only of headache.

Rectal administration is the most satisfactory method of using this salt. It is effective; the patient is spared the discomforts of active catharsis, and the method is applicable in the presence of vomiting, as well as when the patient is unconscious or noncooperative. The dose is 90 gm. dissolved in 175 c. c. of water, introduced slowly through a rectal tube and repeated every four to six hours. The effect is noticeable in about one hour. If a larger amount of water is used the patient may have difficulty in retaining the solution. Unless retained for one-half hour the injection will not produce its full effect, and should be repeated one hour later. If the rectum is irritable, retention of the solution is aided by adding to it 4 c. c. of camphorated tincture of opium. The fluid abstracted from the tissues by the magnesium sulphate accumulates in the rectum and can be siphoned off intermittently by means of a rectal tube.

*Dextrose* is probably the most useful of the hypertonic solutions. When given intravenously it directly increases the osmotic power of the blood, causing a fluid depletion of all tissue spaces. The action of glucose is slower and much more prolonged than that of either sodium chloride or magnesium sulphate. The particular advantages of glucose are: It does not dehydrate the body as severely as do the other solutions; its food value is important in cases re-



quiring prolonged treatment and assists in preventing acidosis; it is of distinct value in relieving shock; and the action of the glucose can be further increased by the simultaneous administration of insulin.

Dextrose is given intravenously, 100 c. c. to 200 c. c. of a 25 to 50 per cent solution, repeated every 8 to 12 hours.

In urgent cases, when a more prompt action is required than can be obtained from glucose alone, it may be given in a 15 per cent sodium-chloride solution; or the sodium-chloride solution may be given first and followed within one hour by the glucose, as suggested by McClure and Crawford (9). In this manner advantage is taken of the prompt action of sodium chloride, while the glucose serves to prolong that action and at the same time tends to prevent the onset of a secondary edema.

#### ADMINISTRATION

All intravenous injections of hypertonic solutions must be made slowly, not exceeding the rate of 3 c. c. per minute, and while the injection is being made the pulse carefully watched. Any sudden change in the rate or quality of the pulse is an indication to stop the injection, which may be resumed after one or two minutes at a slower rate.

The fluid intake of the patient must be restricted, at least during the first 24 hours, but care is necessary to prevent overdehydration. When the edema and pressure have been relieved, the hypertonic solution is continued over a period of 7 to 10 days in gradually decreasing amounts.

When instituting treatment in cases of cranial trauma it is important not to further dehydrate a patient whose circulatory system has already been depleted by shock or hemorrhage. Some degree of shock always accompanies cranial traumatism, and during shock dehydration is contraindicated. However, a dangerous degree of edema will but seldom develop until after the rise of the general blood pressure which takes place during recovery from shock. The onset of increased intracranial pressure is easily determined, for shock is characterized by low blood pressure, low temperature, rapid pulse and respiration, while with increased intracranial pressure and medullary edema there is a gradual rise of the temperature above normal, an increasing blood pressure, the respiration becomes slow, and the pulse slow and bounding, except when the edema has increased to a dangerous degree, in which condition the pulse is rapid and thready, similar to that of shock.

It is in the early treatment of traumatic cases that glucose is particularly valuable, for advantage can be taken of its power to combat shock as well as to prevent the onset of edema.

## OVERDEHYDRATION

A careful check should be kept on the fluid intake and output of patients being treated with hypertonic solutions, and after the first 24 hours sufficient fluid given to almost effect a balance of the two. Fay (6) reports two cases of overdehydration. One came to autopsy, and no fluid was found in the ventricular system. Shortly afterwards he had another case, which developed symptoms resembling those of the first. Fluids were immediately pushed and the patient recovered. Fay gives as the diagnostic symptoms of overdehydration, very rapid respiration, with air hunger, and a rapid, thready pulse, similar to that found after severe hemorrhage. There should be no difficulty in recognizing overdehydration if the increasing respiratory rate is carefully watched for.

## INDICATIONS

Like all other therapeutic procedures, the use of hypertonic solutions must be with an understanding of their limitations as well as their advantages, and in accordance with definite indications.

The most frequent indication for their use is the reduction of the edema and increased intracranial pressure resulting from trauma to the skull. It would be foolish to suppose that they can replace surgery in case of massive brain injury, in depressed and compound fractures, and where there is evidence of hemorrhage and localized pressure from the rupture of a large meningeal artery. Hypertonic solutions have, however, a very definite use as an adjunct to surgery in these conditions—to reduce intracranial pressure during, and lessen subsequent edema following, operation.

The types of cases responding most satisfactorily to treatment primarily with hypertonic solutions are: Simple nondepressed fractures of the vault, fractures of the base, and cases of "concussion" without fracture. These cases when seen early may have a normal or moderately increased pressure of the spinal fluid (10 to 20 mm. of Hg), moderate increase in temperature and blood pressure, normal respiration, moderate decrease in pulse rate, some congestion of the retinal veins on ophthalmoscopic examination, and either partial or complete loss of consciousness. Frequently in cases of this type the surgeon hesitates to operate early, only to find a few days later a sudden and alarming cerebral edema demanding urgent and radical surgery. These cases, however, when treated from the beginning with hypertonic solutions will usually show a rapid return of consciousness; a fall in spinal-fluid pressure; and a short, quiet convalescence with rarely any residual symptoms, such as headache, dizziness, or change of temperament. Milder cases of concussion are relieved of symptoms much more quickly by this method of

treatment than by the "expectant" form. Peet (7) states that since adopting the use of hypertonic solutions the number of operations on his service have been greatly reduced and clinical results much better.

Another condition in which hypertonic solutions have been used successfully is in the presence of a cerebral tumor showing symptoms of excessive pressure, when it has been necessary to give the patient temporary symptomatic relief, to improve his condition for operation, or to facilitate a proper neurological examination. Previously in this paper reference has been made to Haden's use of glucose to reduce an acute intracranial hypertension occurring in the course of cerebrospinal meningitis, and he suggests its use for the same condition complicating other acute infectious diseases, while Howard (10) reports the prompt relief of a patient suffering from acute maniacal delirium by the same means.

There can be no question but that a rational and valuable therapeutic procedure has been developed as the result of the work of Weed and McKibbon (1).

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#### BARBITAL, ITS USES AND MISUSES

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The advantages and disadvantages of barbital and its derivatives have been discussed quite freely in the current medical literature. The purpose of this article is to digest parts of the discussion on the subject and to emphasize its practical application to naval medicine.

There are several popular synthetic hypnotics available at present, including sulphomethane (sulphonal), sulphonethylmethane (trional), phenobarbital (luminal), and barbital or veronal. The latter has received close scrutiny by both lay and professional interests. Due to the pleasing effect they produce, the derivatives of barbituric acid are the most popular. These derivatives resemble each other

very closely in their effects, even though their dosages vary. Phenolbarbital is given in much smaller doses than barbital. This discussion of barbital may well apply to all derivatives of barbituric acid.

Chemically, barbital is diethylbarbituric acid or diethylmalanylurea ( $\text{CO}(\text{HN}.\text{CO})_2\text{C}(\text{C}_2\text{H}_5)_2$ ). The other derivatives of barbituric acid also belong to the malanylurea group. Of these, phenolbarbital and sodium barbital are the most important.

Barbital is usually colorless or in the form of white crystals or powder with a faintly bitter taste, and is stable in air. It is soluble in 130 parts of water, 14 parts of alcohol, 75 parts of chloroform, and 35 parts of ether at 25° C. It is also soluble in acetone and ethyl acetate.

Barbital melts between 187° and 190° C., is acid to litmus in aqueous solution, and yields a white precipitate when treated with mercuric nitrate. When boiled with sodium carbonate for 30 minutes or fused with sodium hydroxide, barbital is decomposed, with an evolution of ammonia. A solution of 0.2 gr. of barbital in 2 c. c. of sulphuric acid or nitric acid is colorless. The usual dosage of barbital is 0.5 gm., or 8 gr.

The toxic dose of barbital is variable. According to Eddy (1) its relative toxicity depends upon the amount taken up by the central nervous system. The toxic action appears to be mainly an intensification of the depression of the central nervous system, which in therapeutic doses produces nearly normal sleep. Eddy gave equal fractions of the fatal dose of various hypnotics to cats and compared their effects with reference to posture, sleep, heart rate, respiration rate, analgesia, rectal temperature, conjunctival reflex, knee jerk, and other conditions, recording more than a thousand observations. None of the compounds were much more actively hypnotic in proportion to their toxicity than barbital and none are relatively less toxic than barbital.

Probably the actual toxicity for man is proportionate to the hypnotic action.

Sollman (2) maintains there is a certain habituation to the drug. It is noted, too, that barbital is prone to lose its effect if given continuously for two weeks. When administered for a long time the bowels must be kept open and alkalies given. Large doses may cause sleep to last for two or three days.

The signs and symptoms of barbital poisoning have been enumerated with frequent addition from time to time. Milder forms show drooling, inability to swallow, and disturbances of articulation. A moderate euphoria is present in chronic addictions. Judgment and orientation as to time and insight are probably the most severely harmed of the psychic faculties and are usually the last to

clear up in convalescence (3). A dulled sensorium and sleepiness are the usual sequence of even a small dose. Blood pressure may be lowered, the heart rate slowed, and the peripheral arterioles dilated. (4). Ataxia, hallucinations, and tremor may also occur (5).

Also, according to M. Andre Tardieu, coma-vigil, acute and sub-acute psychosis, lethargy with asthenia, ocular disorders, salivation and fever, and toxidermia in subjects in a state of hepatic and renal insufficiency, with exanthems resembling those of measles, scarlatina, or erysipelas may be present in the more severe forms.

Lange and Gutterman (7) observed horizontal and vertical nystagmus and sometimes paralysis of the extensor muscles of the eye in 18 cases of poisoning by hypnotics of the barbital group. Claude, Lamache, and Daussy (8) found polyneuritis, which was characterized by pain in the extremities and modifications of the reflexes, in a woman who had taken 15 grams of barbital and 5 grams of phenolbarbital. An alteration of the blood is also noted, manifested by hematorporphyrinuria, a condition in which dark red or almost black urine is passed.

Barbital has an increasing field of usefulness. It is a perfect hypnotic, producing no morning headache if given early in the evening. Phenolbarbital may be given day or night in doses of 0.05 to 0.2 gm. (0.75 to 3 gr.) without after affect. Alvarez (9) states: "These newer synthetics have no relation to morphine; they have none of the kick that makes the taker wish to repeat his experience, and, except in the case of the markedly psychopathic person, I am sure they are perfectly safe. I have been prescribing them for 20 years and have yet to see an habitué in my own practice."

Eberhard (10) recommends the injection of barbital in the treatment of eclampsia. Williams (11) substituted barbital for morphine and atropine, giving 5 gr. one hour before the operation in 52 unselected cases which included tonsillectomies, adenectomies, submucous resections, and antrotomies. In only two instances were there any symptoms suggestive of toxicosis from the anesthesia and these were transient.

M. Reese Guttman (12) found that phenolbarbital is a very valuable drug in the treatment and prevention of acute cocaine intoxication. He has also proved its worth as a preoperative sedative. Its use is rational and is based upon an exact pharmacodynamic study.

Martin (13) found that 10 gr. barbital if given by mouth about an hour before operation will prevent the development of serious toxic symptoms due to the use of local anesthesia.

Bannon and Dragstedt (14) found that parathyroidectomy may be relieved or controlled by the adequate administration of barbital

without any material change in the level of the blood calcium. The life of the parathyroidectomized dog can be prolonged when tetany is controlled in this manner.

Keeton and Nelson (15) found that a toxic dose of barbital is variable, depending upon whether or not an impairment of the kidney function is present. They also found that it is valuable in relieving the nausea and vomiting associated with pregnancy, as well as nausea from other causes that may develop dizziness.

Irvine H. Page, of Munich, says that "clinically there is little doubt of the differences in the hypnotics. There are unquestionably patients that show great resistance to one hypnotic whereas they succumb readily to other hypnotics."

Thus many uses can be made of barbital if prescribed by a physician. Its chief disadvantages are due mainly to the fact that the public can obtain the drug in large quantities and use it at random. Poisonings are becoming more frequent, some being due to increasing use of overdoses, and others are taken with suicidal intent. Work (16) made a study of 100 cases of acute poisoning or chronic addiction with the drug. He points out that the man who is constitutionally or acutely below the standard dulls his sensorium with barbital just as other drugs are used as a refuge from circumstance. Moderate euphoria is produced and the psychic faculties are further harmed.

Barbital and its derivatives have an increasing lay popularity for self-administration. Its habit-forming propensities are sufficiently well recognized to merit the terms barbitalism or veronalism. Ethical offenses are well within the possibilities; the dulled sensorium may lead to quasicriminal complaisance with the schemes of others. Thus safe hypnotics may become menacing to the public welfare.

The writer's interest has been accentuated by the observance of several cases of barbital poisoning during the past year. Some of these were at naval hospitals and two were aboard ship. The public is using veronal quite freely as a sleep producer, for relaxing effect, and even for the relief of pain. It is easily obtained from the druggist without prescription in large quantities. Since the drug may lose its effect if taken steadily, even the chronic habitué is tempted to take larger doses, which frequently result in poisoning.

Naturally, the naval personnel is not exempt. The naval hospitals frequently receive emergency cases of barbital poisoning. Most of these patients do not come directly from their ship or station, but are usually picked up while on liberty, usually as prisoners for being absent over leave.

Close questioning reveals several facts. Those in need of sleep in the daytime, such as bakers and cooks, are particularly prone to take

the drug. Two cases aboard ship were bakers, one of whom had been a chronic habitué for several months. These men used it while on liberty to put a kick in the alcohol they had been drinking, making its effect more lasting. They were under treatment for more than a week before their symptoms disappeared.

Another case was a ship's cook observed at the naval hospital, Mare Island, Calif., in 1928, who had taken about 80 gr. of veronal in addition to considerable quantities of alcohol. He was admitted in an unconscious condition, which required prolonged treatment. This patient's urine showed presence of barbital for several days.

Barbital is frequently used in combination with other drugs. Aspirin is a favorite. The usual tendency of the habitué is to try out several drugs, such as cocaine, and even opium. The personnel on the west coast is acquainted with the marihuana cigarette, which is easily obtained from Mexicans in San Diego, Calif. This cigarette is supposed to be made from an herb grown in Mexico. It is also reported to be found in several of the Western States and is known as loco weed.

A recent case seen at Pearl Harbor hospital, Hawaii, is most interesting. The patient is a baker and seems to be a victim of circumstance. His statements bear the evidence of truth, and his frankness in giving all the information at his command has been very useful in obtaining an insight into the cause of addiction, the method of obtaining the drug, and its effect on the patient. A complete record of this case is given below.

W. V. T., baker, third class, United States Navy; age 25; white. Admitted to United States Naval Hospital at Pearl Harbor, Hawaii, July 3, 1929, at 1 a. m.

*Diagnosis.*—Poisoning, acute (veronal), No. 2605. Result of his own misconduct.

*H. P. T.*—When admitted he was very sleepy and could be aroused only with difficulty. He stated that he had taken veronal. No further details could be obtained at this time on account of patient's mental condition.

*Physical examination.*—General appearance: Patient is sleepy; muscles relaxed; smoothing out of facial expression; flaccid appearance; eyelids droop. Skin: Clammy; sweating of the hands and feet and of body in general; cyanosis of sclera, lips, gums, tongue, finger and toe nails; a darkened tinge is present all over body. Eyes: Conjunctiva is injected; pupils are regular and react to light normally, but are sluggish to accommodation; eye muscle action is retarded. Nose: Apparently normal. Ears: Normal. Mouth: Throat is injected; acid breath; tonsils present and normal; teeth normal. Heart: Normal size and position, but frequently palpitates with skipping of a beat. Lungs: Normal. Abdomen: Normal. Genitalia: Penis has a bluish cast, especially the glans penis. Blood pressure: 120/82. Pulse: 90, after exercise, 104. Respiration: 24. Temperature: 98.6° F. Patient becomes dizzy upon standing and staggers. He has an ataxic walk. The muscles respond sluggishly and are markedly hypotonic. Very inactive mentally. Romberg is positive. Incoordination of movements. Knee jerks are absent. Biceps reflexes are exaggerated. Superficial and cremasteric reflexes are present but are sluggish. No ankle clonus or Babinski.

July 3, 1929. Patient has been asleep since admission except for the purpose of eating and excretion. Later in the day he became more easily aroused. His pulse came down to 78, and respiration to 20. Soft diet with alkalies given.

July 4, 1929. Less drowsy. Has a ravenous appetite. A specimen of dark green urine sent to the laboratory for examination. Positive for barbital. Soft diet continued.

July 5, 1929. Patient is now asking for something to knock him out, and is continually around the medicine cabinet. He is quite depressed, and feels that he would be all right if he were permitted to have a small dose of aspirin or veronal. Complete anorexia. Confined to the brig for safe-keeping.

July 8, 1929. Patient has refused all nourishment offered him since the 5th of July. States that food is revolting to him; that he has lost his taste. Given outdoor exercise and forced to take milk, toast, and orange juice with a dash of lemon.

July 9, 1929. Orange juice with lemon continued. Small fruit salad and dry toast was eaten. Patient managed to procure 10 tablets of veronal and aspirin that he had effectively concealed in his sea bag. He had these hidden in the lining of his pipe case when discovered. He took two tablets of veronal and one of aspirin for two days until caught on July 12th. He has eaten only two normal meals in the last four days. He states that he likes lemons, oranges, dry bread, pineapples, and lettuce with vinegar. Abhors butter, potatoes, and vegetables, and says, "an onion tastes like a fishing worm smells."

July 12, 1929. Patient has worked on the ward to-day. After being returned to the brig he cut himself with a razor, with considerable amount of hemorrhage. He gave as his reasons that it was his birthday and he wanted to celebrate, and also to prove to himself that he was able to cut himself without any pain. This time (he has done this frequently) he made no attempt to stop the flow of blood. A clot formed and he did not reopen the wound but called a corpsman to bandage it. He says he was not afraid, but began to think and decided that he should not cut himself any more. He confessed that he had been taking veronal and aspirin. Several tablets of aspirin were found in his tobacco.

July 15, 1929. Patient is constipated and feels weak, even dizzy at times. He can talk much more freely now, though speech is still retarded. His appetite is still poor, but he gets daily exercise, which seems to relieve his general depression. During his illness his temperature has ranged from 97° F. to 98.8° F. in the afternoon. Pulse, 72 in the morning to 90 in the afternoon. Respiration, 16 to 20.

Patient makes the following statement concerning his addiction: In 1925, while working on night shift as a baker on the U. S. S. *Altair*, he started taking sleeping medicine in order to sleep in the daytime. He does not know if veronal was given to him at the drug store and does not remember the names of the various soporifics he did obtain. He took at this time considerable quantities of aspirin and various other tablets bought in drug stores, with only a few interferences.

In 1927 he began to take veronal and has used this drug and aspirin almost continually since, but usually in small doses. While taking these drugs he feels fine and has a good appetite. He states that he can then do his work well and everyone likes him. Also



he has been successful in concealing his habit from his shipmates. This patient is married and has worked extra hours in order to get more money to send home.

He describes his present illness as follows: He was paid on Monday, July 1, 1929. Then went to town and drank some beer, which made him sick. He purchased one bottle of veronal, 50 gr. (He had not taken much of this drug for several weeks.) He took one tablet, which had no effect, so he swallowed four more tablets, with only slight effect. Then he obtained another bottle of veronal at a Chinese drug store and also bought several packages of aspirin. He shut himself in a room and took most of the remaining tablets of veronal and threw the bottle away.

On Tuesday evening, 24 hours later, the landlady awakened him and asked that he pay for his room. He was in such a stupor that he could not respond, so she called the police. They took him to the Young Men's Christian Association, where he got a taxi for the navy yard. As he came to the gate he pulled out a 2-dozen package of aspirin tablets and emptied the contents into his mouth. These dissolved, but made his mouth very dry, so he asked for water to wash them down. The marine guard took charge of him and sent him to the hospital, where he arrived about 1 a. m. Wednesday.

Thus he thinks that he must have taken 4 dozen aspirin tablets and a hundred grains of veronal before he lost control of himself. He said that he slept soundly in the hospital all the day, except when awakened. He would eat regular meals and was hungry. He would then drop off to sleep again. He was able to get up and stagger around if necessary. His appetite lasted for three or four days; then he did not care for food, since it had no taste, eating only what was forced on him.

He craved more aspirin and veronal and later obtained several tablets of aspirin, which he had concealed in the lining of his coat, and also managed after a few days to get some veronal he had hidden in the lining of his pipe case. He was able to take several tablets of aspirin from the medicine cabinet, but, due to his walking around at night, he was put in the brig for safe-keeping. He consumed several tablets each day for a week; then they were discovered and destroyed. On the 22d of July the patient felt much better.

Patient says he has tried cocaine, but did not like its effect. He has also tried the marihuana cigarette. These are sold in pool rooms in San Diego, Calif., or Tiajuana, Mexico, by Mexicans. A very pleasant sensation of floating away comes, and the feet are light and can't seem to stay on the ground. The patient states that

he and a friend, after smoking a marihuana cigarette, laughed for one hour while just looking at each other.

He says that veronal affects him in a different way; that he feels drunk, his head sags, he is "dead on his feet," and drifts along pulling his feet. Once he ran into a telephone pole, because he has a tendency, when under the influence of veronal, to go about with his eyes shut. He has no pain, and can cut himself without feeling it. He says he gets the idea of cutting off his finger just to prove that he wouldn't feel it if he did. Patient says he does not have to have the drug, but he is unable to resist it.

The above case illustrates the danger of permitting the drug to be obtained at random by the public. M. Andre Tardieu (16), in an address before the Société de thérapeutique, makes an insistent demand that these barbital products be added to the list of toxic substances which pharmacists can not dispense to the public without a medical prescription. A resolution following this address was presented by M. Desesquelle to the effect that all derivatives of malanyl urea be added to the list of toxic substances that may not be dispensed to the public except on a physician's prescription. The resolution was adopted unanimously by the Société de thérapeutique. The Academy of Medicine became alarmed over the increasing number of suicides attributed to the drug.

Even the newspapers recognize the danger of these hypnotic drugs. It is true that barbital and its derivatives are very useful in the field of medicine and should continue to be used. The solution of the problem lies in the restriction by law of the use of these drugs. A medical prescription should be presented to the druggist each time before he is allowed to sell any to the laity. This step may prevent suicidal attempts and other improper uses, and place the responsibility upon the proper authority.

Until legislation is passed we are faced with the possibilities of chronic habitués. At least it is our duty to keep a close check on all the personnel and try to detect those who are users of the drug.

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#### OTO-RHINO-PHARYNGEAL HEMORRHAGES

By A. H. CECHA, Lieutenant, Medical Corps, United States Navy

One of the chief complications with which the practitioner treating diseases of the head must frequently contend is hemorrhage. Due to the vascularity of the tissues involved in operations on the ear, nose, and throat, together with the inaccessibility of the parts, and obstructions to vision in the narrow, irregular cavities through which one must work, bleeding will always be a troublesome element in this branch of surgery. Ligation of blood vessels and suturing of bleeding areas so freely performed on other parts of the body is seldom done in surgery of the head. Reliance is mainly placed upon dozens of preparations, many inefficient, to check the hemorrhage, with the expectation that the coagulability of the blood and the contractility of the vessels will be sufficient to maintain a dry field. The object of this article is to indicate the causes and sources of hemorrhage and to mention the various means at our disposal to prevent and control hemorrhage as applied to ear, nose, and throat practice.

In favorable conditions bleeding from the vascular system is stopped by the process of blood clotting. The process is a complex one and not entirely understood. Physiologists are agreed that blood clotting consists of a series of changes, the end result of which is a substance called thrombin which acts upon fibrinogen, thus forming a clot. Both thrombin and fibrinogen are specific substances which can be isolated and their properties demonstrated. Although we can not explain the entire phenomenon of blood coagulation, we know enough concerning the physical, physiological, and chemical features

of this process so that in our surgical practice we can avail ourselves of substances that are of value in initiating and accelerating this process.

#### BLOOD CLOTTING RATE

As an index to what one may expect in bleeding, reliance is placed to a certain extent upon laboratory determinations of bleeding time and clotting time. Both factors should be kept in mind, for while they usually correspond such is not always the experience of the laboratory technician nor of the operator. There is much difference of opinion as to the value of a routine laboratory test for blood-clotting rate; some men carry out this test regularly while others disregard it entirely. I believe that it is the experience of all surgeons that often when the report shows a clotting rate as low as two minutes one will have an oozing of blood, while in other cases when the test shows a rate of five or six minutes the field is absolutely dry. I believe that the factors that influence the bleeding time can explain this paradox. I have observed at some institutions where this particular branch of surgery is extensive that no routine test for coagulation is made; at the Mayo Clinic, for instance, no test is made, but in its place a history is taken which will bring out any tendency on the part of the patient to frequent or prolonged hemorrhages. At the present time it may be said that for one's own protection against unjust criticism and for the confidence that this simple procedure inspires in the patient this test should be performed; perhaps some unsuspected hemophiliac will be discovered who would otherwise be overlooked.

As a simple means, the capillary-tube method is usually employed in testing for blood coagulation; the blood is taken from the ear; if it is taken from another part of the body at the same time there may be a variation in the rate. The coagulation rate when the blood is taken from a skin incision averages three and one-half minutes; it is twice as long when the blood is drawn directly from a vein.

#### BLEEDING TIME

Bleeding time is closely associated with the relative number of blood platelets in the blood stream; when the platelets in the circulating blood fall below 100,000 per c. mm. there is a tendency to prolongation of the bleeding time. While coagulation time depends exclusively upon the properties of the blood itself, bleeding time is dependent, in addition, upon the condition of the cardiovascular system and the nature of the wound. It is just in this place where the operative technic comes into consideration, e. g., in using blunt or sharp instruments, in leaving tags of tissue in the nose, in partly removing a tonsil, in leaving adenoid strips in the nasopharynx, in

the method of using nasal and tonsil snares, and in elevating or cutting mucous and fibrous tissue. Also, there are other factors which influence bleeding time, such as persistent hawking; excitability, anxiety, and restless tossing; high blood pressure with or without arteriosclerosis; and the injudicious use of drugs.

#### NATURAL ARREST OF HEMORRHAGE

Nature attempts to stop a hemorrhage by contracting the end of the severed blood vessel, thereby reducing the size of the lumen, and retracting the vessel into its sheath. If the vessel is cut lengthwise it will be impossible for it to retract or even to contract normally. If the vessel is crushed the inner coats will curl up within the outer so that the lumen will be diminished in size, thereby assisting in clot formation and making it possible for the clot to retain its position. By using blunt dissecting instruments and large-size snare wire it will be possible to crush the blood vessels and thus help to diminish bleeding. It is noticed that when tissues are contused or lacerated hemorrhage is less profuse and not so long continued as when clean-cut wounds are made. These lacerations stimulate the coats of the blood vessels to contract and retract and are an aid to clot formation. Diet has a special bearing upon hemorrhage, as it influences coagulability; items of food that contain lime salts or magnesium carbonate promote clotting; on the other hand, a vegetarian diet, diminution of lime salts, presence of citric acid, intake of large quantities of fluid, or a restriction of food lessens the coagulability of blood. It is not wise to restrict the normal amount of food for any length of time before or after an operation, as is often done when the tonsils are removed.

#### SPECIFIC HEMORRHAGIC DIATHESSES

A prototype of a hemorrhagic disorder is found in hemophilia. Here we are dealing with a condition in which the blood coagulates slowly, though the clot, when once formed, retracts normally. The bleeding time is normal when tested by the usual small puncture wound. Associated with this condition is a qualitative defect of the blood platelets, although they are present in normal or increased numbers. It is dangerous for this type of patient to have any kind of wound, for the application of sutures or the use of a direct cautery will not check the flow of blood. In conjunction with local pressure the local application of normal blood on a dressing will assist clotting; horse serum, adrenalin, extracts of thyroid, thymus, or ovary are available for a similar use. For the same purpose, to be given intravenously, fresh horse serum or anti-diphtheritic serum are readily available. However, when there is

much loss of blood nothing can take the place of a blood transfusion, both to assist clotting and to reduce the shock by replacing the volume of blood lost.

Chronic thrombopenic purpura is characterized by a prolonged bleeding time; the blood platelets are greatly reduced in number; the blood clots in the usual normal time, but the clot has little or no tendency to retract, which is in contrast to the hemophilic clot which retracts normally.

There exists a third type of hemorrhagic disorder, a chronic familial hemorrhagic condition, described by Minot (1), characterized by a prolonged bleeding time, with no decrease of blood platelets, and a delayed coagulation time. Multiple ecchymoses and recurrent epistaxis are characteristic symptoms. Abnormal bleeding time may be present at one time and not at another. This hemorrhagic condition appears in infancy and may extend into adult life, but then its severity tends to decrease and the condition may disappear as the patient grows older.

#### FREQUENCY OF HEMORRHAGES

It is impossible to give with any degree of accuracy the percentage of hemorrhages in any class of operations on the ear, nose, or throat; it is certain, however, that anyone who has performed a large number of operations has had annoying hemorrhages to deal with. General observations show that they are more frequent than one could infer from the medical literature. Fortunately, not all hemorrhages are of the severe type—the milder type predominate—so that as a whole they do not produce any undue anxiety. It is only in the smaller number that there is real difficulty in managing the patient and checking the hemorrhage.

#### EAR HEMORRHAGES

Ear hemorrhages are not common, and when they occur are self-limited or can be easily checked by appropriate means. Bleeding from the ear following fractures of the middle fossa of the vault are common but usually stop spontaneously without much loss of blood. Bleeding due to incision of the drum membrane occurs but ceases shortly without the necessity of packing the external auditory canal. In mastoid operation hemorrhages will occur if the sigmoid sinus is opened or its necrotic coats become exposed. In the former condition the hemorrhage is profuse, but due to the low venous pressure it can be stopped by inserting an iodoform packing between the sinus wall and the external bony covering; in the latter condition oozing of blood takes place which is very persistent and interferes with the progress of curettement. If hot compresses do

not produce results an advanced necrosis exists, not only of the sinus plate but also of the sinus wall which will have to be curetted and the sinus opened, thereby treating it as an open wound. In hemorrhages from small blood vessels coming through the bone either closing the bony orifice with a small punch and mallet or application of bone wax to the bleeding point will stop the bleeding.

#### NASAL HEMORRHAGES

In comparison to ear hemorrhages, bleeding from the nose is very common. Some of the causes are ulcer of the septum located either anteriorly or posteriorly, hypertension, arteriosclerosis, anemia, scurvy, purpura, cardiac or renal lesions, and operative wounds causing primary or secondary hemorrhages. Simple nonoperative hemorrhages can be checked by having the patient assume the recumbent position and applying cold compresses to the nose, forehead, and back of neck; if the hemorrhage is profuse, nasal packing will have to be done; if the bleeding point can be seen, application of an astringent will bring immediate results and at the same time will be more comfortable to the patient. In chronic hemorrhages due to an ulcer of the septum, the septal blood vessels are at fault, the ulcerated area lacks sufficient nutriment for complete healing, and the muscular walls of the blood vessels have lost their power of contraction. Application of a styptic causes a crust to form which will, after a time, become dislodged and bleeding resumed. A better procedure is to use the actual cautery, applied 2 or 3 millimeters from the circumference of the ulcer, which will separate the normal vessels from the diseased portions, healing taking place with scar formation. Elevation of the mucosa will improve the circulation, and, consequently, the nutrition by relieving the pressure on the blood vessels, so that rapid healing occurs. In hemorrhages in the posterior nasal air passages a nasal tampon drawn forward from the epipharynx into the nose is the most satisfactory immediate treatment; however, as these chronic hemorrhages are due so frequently to pressure ulcers from deviations, a submucous resection will later have to be performed. Nonoperative hemorrhages from the nose usually come from the septum, as the vascularity of the lateral walls of the nose aid rapid healing. Operative hemorrhages of the lateral nasal wall are due to injuries to the sphenopalatine vessel and are primary; bleeding may last for 24 hours or more; secondary hemorrhages are due to ulcerations formed in necrotic tissues, so that where packing can not be directly applied the necrotic tissues must be first removed by curettement and then packing applied.

## THROAT HEMORRHAGES

In the oro-pharynx removal of the tonsils and adenoids gives us the chief concern for hemorrhage. Here hemorrhage may be primary, intermediate, or secondary. The cause in a tonsillectomy may be due to the technic in removal, the character of the tonsil tissue, or the condition of the blood and of the vascular system. Hemorrhage or profuse oozing is mainly found either in the supratonsillar or infratonsillar recesses if no injury is done to the muscular walls of the fossa; the most common site is the lower space, as in this location is found the muscular attachment of the tonsil with its plexus of blood vessels. The muscular attachment, together with the structure of the tonsillar anatomy, has been described by R. H. Fowler and T. W. Todd (2); their study gives us more detailed information about the structural relationship of the tonsil which is helpful in operative technic. Another cause of bleeding is found when a tag of tonsillar tissue is left in the lower recess; it should be removed as a prophylactic against hemorrhage as well as for curative purposes. Large hypertrophied tonsils that have become fibrous through repeated inflammation are less liable to cause trouble either during or after their removal. Small buried tonsils leave a small tonsillar fossa which is covered by the pillars; these pillars act as compresses, so that one does not expect to see a postoperative hemorrhage when favored such an anatomy. Large soft tonsils that are closely bound to the tonsillar fossae and pillars and which fill the upper and lower recesses are the ones that are liable to bleed, as there is more cutting required and the vascularity is more extensive. The denuded area should be perfectly dry when the patient leaves the operating room; assurance in this respect will eliminate much concern after the patient passes into the ward.

Intermediate hemorrhages seem to me to be due to the dilatation of the blood vessels following the use of too much epinephrin in the local anesthetic solution; this reaction may occur from 2 to 10 hours after operation; as a hemostatic, as little as 3 minims added to the procaine solution will suffice for both tonsils. Following a general anesthesia a reactionary hemorrhage may occur when the blood pressure rises due to the restlessness of the patient and the increased heart action.

Secondary hemorrhages occur during the healing period and are noted about five or more days after the tonsillectomy. They are due to a sloughing of the tissue at the lower part of the fossa where the tonsil was snared off from its muscular attachment. While not serious, they are persistent, for the usual hemostatics do not permanently control them. Being a capillary hemorrhage, they are more easily controlled by placing one suture through the lower ends



of the pillars which then cover and compress this area. Direct suturing is not so easily done and, besides, it may require several sutures for complete control.

When a hemorrhage is profuse it usually comes from a single vessel. If the patient is intractable and it is difficult to locate the bleeding point, the only satisfactory procedure is to anesthetize the patient, which enables one to carefully survey the entire field, apply a hemostatic forceps, and ligate the vessel. There are a number of specially constructed hemostatic instruments on the market which facilitate the ligation of blood vessels in inaccessible locations.

There is a greater frequency of hemorrhage when using the tonsil guillotine than when removing the tonsil by the snare. In using the snare a large-size wire, as a No. 9, should be used and the tonsil should be snared off slowly, preferably closing the snare intermittently.

Pressure hemostatic instruments such as Mikulicz's clamps have not proved a success; they do not produce pressure at the desired point, do not stay fixed in position nor maintain uniform pressure, and are most uncomfortable to the patient; besides, they devitalize the tissue as a result of the compression.

In removal of adenoids the use of dull instruments prevents hemorrhage. If hemorrhage occurs hot saline gargles are of real benefit in checking the bleeding, so that packing is seldom or never required.

#### GENERAL MANAGEMENT OF PATIENTS

Since hemorrhages from the ear, nose, and throat may be due to other than local causes, it is imperative that a brief history be taken, the necessary physical examination made, and laboratory tests performed that will bring out any hemorrhagic tendency.

Prior to operation the patient should not be starved and after the operation he should resume his normal diet immediately if he is able to do so.

The patient should leave the operating room with a dry field; it is better to spend additional time to be certain in this respect than to be called later to treat the bleeding when it will be difficult to manage the patient. The patient should be seen shortly after the operation, for if hemorrhage is to occur it is more apt to appear within an hour or two after the patient has left the operating room. Reliance in this matter can not be placed on instructions to patients or upon the hospital corpsman's observations, as they both fail at times. The dressings should be examined, and in the case of tonsillectomies a strong artificial light should be projected into the posterior pharynx behind the tongue to see whether streaks of bright red blood are present; such indicate that hemorrhage is occurring

somewhere. All massive blood clots should be removed, as they may conceal a hemorrhage. If the patient is restless, coughs frequently, and continually clears his throat, a hypodermic injection of morphine is valuable in maintaining composure and lessening the tendency to bleeding by lowering the blood pressure and steadying the heart action. No atropine should be combined with morphine, as cases are on record (3) where atropine was the cause of secondary bleeding.

Young children and aged patients stand the loss of blood very poorly; among them a collapse may occur before the usual signs of bleeding become evident. A frequent examination after operation will forestall such an occurrence.

In difficult cases of tonsillar hemorrhage the best security one has against a repetition of bleeding is to anesthetize the patient and to place a suture around the bleeding vessel. To do this promptly one should, when the blood comes from the upper recess, place a ligature transversely through the tissues above the bleeding point, for the blood comes from a descending vertical vessel; when blood comes from the lower recess the ligature should be placed below the bleeding point, as in this locality the vessels ascend in a vertical direction.

#### VARIOUS PREPARATIONS USED AS HEMOSTATICS

The list of drugs and biologic products recommended for control of hemorrhage is almost endless. These preparations are used locally, hypodermically, intravenously, and orally. Usually some astringent is applied locally to constrict the blood vessel and to hasten clot formation; among these may be named gallic acid, tannic acid, silver nitrate, alum, aluminum acetate, chromic acid, and various compounds of iron; a crust will form and the bleeding will cease, but in chronic bleeding the crust will be dislodged by the oozing blood, so that another attempt will have to be made to control the hemorrhage. Iron solutions are not satisfactory hemostatics; while they quickly cause a large coagulum to form, this coagulum becomes a nasty disagreeable mass in the cavity which the patient attempts to get rid of. A useful preparation made from two common astringents is described by Wilson (4);  $3\frac{1}{2}$  grains of gallic acid and 320 grains of tannic acid are dissolved by heating in enough water to make 1 fluid ounce; the result is a thin mucilaginous solution which is used for local intranasal and intrapharyngeal application. Epinephrin and ephedrine are simple vasoconstrictors whose effects endure for too short a time to be reliable.

Many proprietary products are sold under the names of coagulose, thromboplastin, coagulin, and hemogulen; they are organic prepara-

tions obtained from various tissues and are applied locally or injected into the system.

Orally or intravenously large doses of calcium are given prior to and subsequent to operations; this treatment is particularly indicated in jaundiced patients. Hemostatic serum in the form of pure horse serum is administered intravenously for rapid action; if it can not be obtained, antidiphtheritic serum may be substituted. One should remember the possibility of a serum reaction.

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#### THE LOCAL APPLICATION OF ASPIRIN FOR CONTROL OF POSTEXTRACTION PAIN

By R. B. PUTMAN, Lieutenant, Dental Corps, United States Navy, and L. D. MITCHELL, Jr., Lieutenant (Junior Grade), Dental Corps, United States Navy

Dental postoperative pain is considered to be often due to an error in technic, either of the preparation or administration of the local anesthetic or of the operation itself.

A too hot or too cold solution, or one not isotonic, and muscle infiltration, or too great pressure in injecting the fluid with subsequent death of the compressed cells, are recognized as being among the chief causes of pain following the removal of teeth.

In the operation of removing teeth, excessive trauma, caused by chiseling, burring, or the use of elevators, will in all cases cause more or less postoperative pain. As this trauma, as well as the introduction or retention of infection in the sockets, is sometimes unavoidable, even the most careful operator is often confronted with the problem of considerable afterpain.

In the treatment of postoperative pain it is generally agreed that, ordinarily, the introduction of gauze dressings is not indicated, as the blood clot is thereby interfered with, and the wound must be disturbed when the dressings are changed or removed. There are cases, of course, where drainage must be established and maintained, but as a rule it is preferable to rely upon the organization of the initial blood clot to bring about a rapid closing of the wound. How-

ever, in extreme cases of postoperative pain, in order to afford relief, this procedure must be altered.

For many years dental surgeons have used drugs of the phenol and creosote groups in painful sockets with more or less success, but also with an appreciable burning of tissues and a considerable delay in the healing of the wound. General sedatives have also been used with success, and are indicated in a great many cases. Aspirin is probably the most common sedative used, but the writers do not recall having heard or read of the local use of powdered aspirin for the control of pain following the extraction of teeth.

The nose and throat clinic of the United States naval hospital, Chelsea, Mass., uses a spray of powdered acetyl salicylic acid in post-operative treatments of tonsillectomy, which suggested its use in the treatment of pain following exodontia. As aspirin, according to Buckley, has decided antiseptic qualities, its use for this purpose was considered advisable. Consequently, the following procedure was inaugurated. In every case of extraction where there is evidence of an osteitis, with tardy bleeding and clot formation, a minute quantity of powdered aspirin is gently sprayed directly into the sockets, and particularly on the lacerated tissues at the orifice of the wound.

In practically all cases where this treatment has been used it has met with gratifying results, the patient reporting but slight soreness.

In cases where the treatment was not used and the patient returned complaining of pain, the socket was irrigated and the aspirin sprayed in, with almost immediate relief from pain.

No irritation of the mouth or poisoning has been observed, although Buckley gives the promiscuous use of aspirin (internally) as a frequent cause of rather severe poisoning, the symptoms being edema of the lips, tongue, eyelids, nose or entire face, and occasionally an erythematous rash.

In cases where the removal of the tooth is accomplished without difficulty and with a minimum of traumatism and laceration of the investing tissues, and where there is a good clot formation, the treatment is believed unnecessary.

The patient in these cases should be warned against introducing anything into the wound or into the mouth that might interfere with or cause the removal of the blood clot. If a mouth wash, such as hydrogen peroxide or sodium perborate, is being used by the patient it should be discontinued temporarily, as it will act as a blood-clot solvent, greatly retarding the organization of the new tissue in the socket. In fact, the patient should be advised to refrain from washing the mouth out for several hours at least, if possible, and then only very gently.

The spraying of the powdered aspirin over the lacerated and inflamed tissue surrounding the tooth socket has a remarkably analgesic effect, and when used sparingly and not too often seems to act as a vasoconstrictor.

In cases of "canker sores" and abraded and inflamed spots in the mouth caused by friction of dentures, this same treatment has been used with very good results.

The use of too much aspirin seems to have an irritating effect on the tissues. Two or three applications daily, even in cases of marked pain, have been sufficient.

Particularly in cases where there is a slough, and, in fact, as a routine, the wound is carefully and gently irrigated before applying the powder.

Care must be taken that powder is not inhaled by the patient, as it causes coughing and an unpleasant irritation of the throat.

As this is such a simple and apparently effective measure for controlling postoperative pain, it is believed that its use in all cases where pain is experienced will, in a large percentage of cases, prove of value.

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#### THE TREATMENT OF SYPHILIS

By W. K. Hicks, Lieutenant (Junior Grade), Medical Corps, United States Navy

Many doctors have asked the syphilologist to outline a standard treatment of syphilis and have been disappointed in that this can not be done.

It is estimated that clinically 80 to 85 per cent of cases who cooperate can be cured.

The patient should understand that rest, nourishing foods, and temperate habits constitute an important part of the treatment. To treat syphilis confidently, one should know the action and value of the drugs used. The treatment centers about four drugs, of which a short review is given below.

Mercury has a strong parasitocidal action, but it has as toxic a reaction upon the body cells as upon the spirochetes; thus it has a chemotherapeutic index of 1. In comparison, bismuth has an index of 5, arsphenamin 10, and neoarsphenamin and sulpharsphenamin 15. In doses used, mercury has only a slight parasitocidal action, but maintains a negative reaction by inhibiting the development of the spirochetes. Many authorities believe this drug stimulates the immunity. It is undoubtedly true that mercury has an affinity for syphilitic tissues and exudates of the tertiary stage. The majority of modern syphilologists believe that mercury still has a firm place in the treatment of syphilis and doubt the wisdom of substituting bis-

muth for the older drug, at least until future years substantiate the claims for bismuth. Inunctions of 50 per cent mercurial ointment are admittedly the best method of administration, but the type of patient treated in the service does not react kindly to the daily rubs. The soluble salts of mercury are superior to the insoluble salts both in therapeutic and local reaction. It is easier, however, to control a careless patient by having him come once a week for the salicylate of mercury than twice a week for the bichloride of mercury. I believe the treatment of choice is the bichloride of mercury in oil given twice a week.

Bismuth, the much-discussed newcomer among the antisypilitic drugs, has established for itself a permanent place by reason of its low toxicity to the body cells and high spirocheticidal property. Bismuth is less spirocheticidal than the arsphenamins or mercury. Much larger doses can be given, however, with greater destruction to the spirochetes, than by giving the limited doses of mercury. Undoubtedly bismuth has greater penetrating powers than the arsphenamins or mercury and is recommended in the resistant and chronic cases. Klauder (7), Hopkins (8), and McCafferty (9) have reported favorably upon cases treated by bismuth alone. Unquestionably, bismuth is rapidly replacing mercury in treating routine syphilitic cases, but its proper place at present is as an alternate for mercury. Stomatitis and the "blue gum line" may occur, but the complications are neither more severe nor more frequent than with mercury. At the naval hospital in Washington we have obtained gratifying results by using a preparation of 1.5 per cent aqueous solution of bismuth sodium tartrate. It is absorbed more rapidly, and therefore the concentration of bismuth in the tissues is greater than with the more slowly absorbing oily preparation. There is comparatively little pain or induration in the buttocks following an injection. Due to its rapid absorption, it is given twice a week in 2 c. c. doses until a course of 10 to 12 injections has been given.

The iodides have no specific effect upon the spirochetes, but they do have a resolving effect upon granulomatous tissue. They doubtless aid in the removal of minute exudates from various organs, thereby giving the arsphenamins access to the spirochetes. Potassium iodide is the most satisfactory drug for oral administration. Complications are few and are not serious, acne, rhinitis, and irritation of the gastrointestinal tract being the commonest. The dose is 15 to 60 grains three times a day.

The arsenicals act by combining chemically with the spirochetes and do not stimulate the cellular resistance or develop immune bodies. Arsphenamin is the best spirocheticide known to-day, but it

is the most difficult to administer. A mild type of reaction is said to follow the use of arsphenamin of 0.6-gram doses in 10 to 20 per cent of cases. Neoarsphenamin is about one-half as spirocheticidal as arsphenamin. It varies in toxicity and therapeutic effect in market lots, and care should be taken in its selection. Kolmer (1) states that it is possible to secure neoarsphenamin in which the injection of 0.9 gram is practically equivalent in curative activity to 0.6 gram of arsphenamin. Neoarsphenamin gives a mild toxic reaction in 2 to 10 per cent of cases who have received from 0.6 to 0.9 gram doses. When neoarsphenamin conforms to the above-stated conditions it is the arsenical of choice.

Sulpharsphenamin is a newer drug than the arsenicals previously mentioned, and its value in syphilis is not as yet definitely settled. It is as spirocheticidal in doses of 0.4 gram intramuscularly as 0.6 gram of intravenous neoarsphenamin. It has a high penetrating power and is especially valuable in congenital and tertiary syphilis. Undoubtedly sulpharsphenamin has great possibilities. It can be given subcutaneously, intramuscularly, and intravenously.

In using the arsenicals, one should estimate the dosage according to the weight, sex, age, and physical condition of the patient. The only real contraindication is hypersensitiveness to arsenic, as manifested by certain symptoms following injections, and by jaundice and dermatosis. Nephritis, aneurysm, aortitis, advanced diabetes, tuberculosis, and pregnancy, however, are conditions in which arsenicals should never be used except in emergencies, and then only in small amounts. If possible, the diagnosis should be made by the dark field, and treatment should be started before the Kahn test becomes positive. The complement-fixation reaction does not appear until 10 to 14 days following the appearance of the chancre.

The following outline of treatment should not be considered dogmatic, but may be used as a guide:

(a) Acute and primary syphilis in which the blood was never positive.

1. Ten weekly intravenous neoarsphenamin injections, 0.3 gram for the first injection, 0.5 gram the second, and 0.6 gram thereafter.
2. Ten weekly injections of mercury.
3. Eight weekly injections of neoarsphenamin.
4. Five weekly injections of bismuth (aqueous solution).
5. Six weekly injections of neoarsphenamin.
6. Ten weekly injections of bismuth or mercury.

Total, 49 weeks of treatment, during which time 13.2 grams of neoarsphenamin were administered. This completes three courses, and further treatment can now be discontinued. The blood should be tested at intervals for three years.

(b) Acute and primary syphilis in which the blood was positive before treatment began.

1. Ten weekly injections of neoarsphenamin.
2. Ten weekly injections of mercury.
3. Blood tested after each course. When it is found to be negative, the treatment suggested in (a) is carried out.

(c) *Secondary syphilis*.—This is similar to the treatment of the primary stage in which the blood is positive.

(d) *Latent syphilis*.—The tertiary or "early" latent cases may be treated as outlined in (b). The "late" latent cases include those who have had untreated asymptomatic syphilis for years and those who have received insufficient treatment with a return of positive serology. With these cases it is best to begin with two months of mercury and potassium iodide. This reduces the chance of producing a Herxheimer reaction. Alternate courses of mercury and bismuth then follow, as in (b). Potassium iodide is given along with the mercury or bismuth. Due to the higher age average of this group, the intensity and amount of treatment varies considerably.

(e) *Kahn-fast cases*.—These should not be considered so until at least three complete courses of treatment have been tried. When no treatment succeeds in producing a negative serology, a yearly course of potassium iodide may be advised. Some authorities add a mercury or bismuth course to the potassium iodide. The spinal fluid must be examined in these cases. Every two years a complete physical examination, that includes an electrocardiogram, is made to determine if the syphilitic condition is progressing. The cerebrospinal and vascular systems are especially susceptible to invasion and must be carefully watched.

We believe that one year of active treatment is necessary following the first negative blood test. No rest periods are advised between courses. A cure should not be announced until three years have passed with no treatment and no recurrence of a positive blood. It should be remembered that a negative blood in latent or early treated syphilis is no guaranty of a negative spinal fluid. A negative spinal fluid one year after infection gives an excellent prognosis as regards future cerebrospinal syphilis. The total amount of treatment given each patient should be conscientiously recorded in the proper place in the health record. This point is stressed, because if not carried out the proper knowledge of a case is lost.

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## CLINICAL NOTES

### TYPHOID FEVER—REPORT OF THREE CASES DIAGNOSED AND TREATED ON BOARD THE U. S. S. "RELIEF"

By J. M. McCANTS, Lieutenant Commander, Medical Corps, United States Navy

Typhoid fever is now so rare in the Navy that one is prone to forget that such a clinical entity exists. The following cases will remind us that typhoid fever must still be considered in our differential diagnoses. Several other points of interest will be brought out in the discussion which follows.

#### CASE NO. 1

C. L. K., seaman, second class, readmitted February 18, 1929.

*Diagnosis.*—Undetermined (cerebrospinal fever).

*Complaint.*—A "throbbing, stiff neck."

*Family History.*—No bearing on present illness.

*Past history.*—Of little importance, except that typhoid prophylaxis was received three and one-half months ago.

*Present illness.*—The patient began to feel ill several weeks ago with headache and constipation. About a week ago a few boils were incised. During the last few days patient has had chills, fever, and a headache, also a severe sweat to-day. Denies sore throat, vomiting, eruption, or pain, except headache and stiff neck.

*Physical examination.*—A well-developed and nourished white, single male, 22 years of age. Appears to be acutely ill. Temperature, 104.6° F.; pulse 100; respiration, 20, on admission. Slight furunculosis over back. A recently incised boil in left axilla. Tender lymph gland left axilla. Posterior cervicals are enlarged but not very tender. Brudzinski negative. Kernig suggestive. Conjunctivae injected. Throat congested. Tongue furred with red papillae showing through. The heart is apparently normal with a faint sound at apex suggestive of a systolic murmur. Lungs negative. Abdomen negative. Genitalia negative. Extremities negative. Reflexes normal. Blood pressure, 110 systolic, 70 diastolic.

February 21, 1929. Since admission has had a severe chill and sweat daily. No pain. Dullness over posterior aspects of both lungs on percussion, especially as apices. Has a slight headache and general abdominal tenderness.

*Treatment.*—Typhoid routine.

*Subsequent course.*—A continued fever, with morning remission and evening exacerbations. For a few days, ninth to the twelfth day, inclusive, after admission, the fever did not exceed 100.8° F. It then rose sharply to 105° and remained from 103° to 104° F. for five days. This was followed by a hectic type of fever, which gradually became less severe until convalescence was established on the thirtieth day after admission. The pulse was relatively slow at first.

The following laboratory findings are briefly summarized:

*Urinalyses.*—Negative.

*Blood counts.*—W. B. C. repeatedly near lower limits of normal with a relative lymphocytosis.

*Blood smear.*—Negative for malarial parasites.

*Spinal fluid.*—Negative.

*Blood Kahn.*—Negative.

*Sputum.*—Negative for acid-fast bacilli.

*Blood cultures.*—

February 19, 1929. Positive blood culture for *B. typhosus*. Identified by morphological, cultural, and serological studies. Living organisms agglutinated with *B. Typhosus* agglutinating antiserum in dil. of 1-6,400. No agglutination with para A or para B antiserum.

February 25, 1929. Negative blood culture.

February 27, 1929. Negative blood culture.

*Feces.*—*B. typhosus* isolated from feces February 28, 1929. Organisms identified by morphological, cultural, and serological studies.

*Widal using living cultures.*—Positive agglutination with *B. typhosus* in dil. 1-400 on March 11, 1929 and in dil. 1-640 on March 17, 1929.

*X ray of chest.*—Essentially negative.

Patient transferred on March 23, 1929.

#### CASE NO. 2

A. E., engineer, second class, readmitted from same ship as case No. 1 on March 5, 1929.

*Diagnosis.*—Pyelitis, acute.

*Chief complaint.*—Headache.

*Family history.*—No bearing.

*Past history.*—No bearing except that patient had typhoid prophylaxis 3 years ago, has been working in laundry on board his ship, and has been ashore only 2 hours during past 7 weeks.

*Present illness.*—Has been feeling below par for two weeks. No epistaxis. Severe headache began February 22, 1929, and was put on sick list February 26, 1929. Chief symptoms then were headache, constipation, and fever. No chills; no sweats. Anorexia, but no nausea or vomiting. No eruption noted.

*Physical examination.*—A fairly well developed and nourished white, single male, 23 years of age. Appears to be acutely ill. Temperature, 103° F.; pulse, 114; respiration, 20, on admission. Few rose spots over anterior chest and abdomen. Eyes dull. Conjunctivae anemic. Tonsils out. Tongue furred and tremulous. Heart and lungs negative. Abdomen negative, except for rose spots. Genitalia negative. Extremities negative. Kernig and Brudzinski negative.

*Treatment.*—Typhoid routine.

*Clinical course.*—

March 12, 1929. Continued fever with morning remissions and evening exacerbations. Pulse relatively slow. Spleen not palpable. Typical typhoid state with moderate mental torpor. One chill since admission. Highest fever this date, 100° F.

March 19, 1929. Temperature normal and convalescence established.

March 23, 1929. Transferred.

The following laboratory work is summarized:

*Urinalyses.*—Negative.

*Blood count.*—R. B. C., 3,950,000; hemoglobin, 72 per cent; W. B. C., 6,550; neutrophils 59 per cent; lymphocytes 40 per cent; transitionals, 1 per cent.

*Blood smears.*—Negative for malarial parasites.

*Blood Kahn.*—Negative.

*X ray of chest.*—Essentially negative.

*Blood culture.*—Negative March 5, 1929.

*Urine culture.*—Negative March 8, 1929.

*Fecal culture.*—Positive for *B. typhosus* March 11, 1929. Organism identified by morphological, cultural, and serological studies. Positive agglutination with *B. typhosus* agglutinating antiserum in dil. of 1-200.

*Widal tests.*—Macroscopic. Living broth cultures:

March 11, 1929. Negative in all dilutions using *B. typhosus*, para A, and para B organisms.

March 17, 1929. Positive agglutination with *B. typhosus* in dil. of 1-320. No agglutination with para A or B.

Widals with stock formalized antigens were negative.

#### CASE NO. 3

W. R. W., fireman third class, readmitted October 26, 1929.

*Diagnosis.*—Undetermined (pneumonia, broncho).

*Chief complaint.*—Pain in chest and headache.

*Family history.*—No bearing.

*Past history.*—No bearing except that patient received typhoid prophylaxis in January, 1929.

*Present illness.*—Admitted to sick list of his ship October 22, 1929, with symptoms of acute catarrhal fever. The condition later suggested broncho-pneumonia and patient was transferred to U. S. S. *Relief* October 26, 1929. States that illness began with a headache, fever, and pains in chest. Vomited once or twice. Anorexia. Bowels regular. Patient too sick and stuporous for reliable history.

*Physical examination.*—A well-developed and nourished white, single male, 20 years of age. Temperature, 104° F.; pulse, 90; respiration, 24, on admission. Appears to be acutely ill and mentally dull. Face flushed. Conjunctivae injected. Pupils contracted, but react to light. Pharynx congested. Tongue heavily coated. Heart and lungs essentially negative. Slight abdominal tympanites. Extremities negative. Kernig and Brudzinski are both suggestive.

October 30, 1929. Mental torpor. Abdominal tympanites definite. Fever, 103°-104° F. Tongue coated. Anorexia continues. Rose spots over abdomen. Pulse relatively slow. Condition very suggestive of typhoid fever. Typhoid routine instituted.

November 4, 1929. There is no evidence of pneumonia. Continued high fever with relatively slow pulse. Tongue coated, tremulous, and red at the edges. Mental torpor, with occasional slight delirium. W. B. C. normal. Developed rose spots several days ago. Slight abdominal distention with moderate diarrhea (three to five times daily). Vomited twice since admission. Spleen slightly palpable. There have been signs of meningeal irritation, but no definite signs of meningitis. Patient is in a typical typhoid state.

Subsequent course: The diarrhea ceased, the tympanites disappeared, the fever gradually subsided, the appetite returned, and convalescence was established November 15, 1929.

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The following laboratory tests are summarized:

*Urinalyses.*—

October 28, 1929. Heavy trace of albumin and a few leucocytes.

November 25, 1929. Negative.

*Blood counts.*—Several examinations showed W. B. C. at upper limits of normal and usually a normal differential. One count showed a relative lymphocytosis.

*Spinal fluid.*—Under slightly increased pressure, but otherwise negative.

*Bedside X ray of Chest.*—October 29, 1929. There is hazy detail in both lower lobes, with increased density in right lower. Appearance suggests broncho-pneumonia without complete consolidation.

October 30, 1929. Bedside X ray of chest compared with examination of October 26, 1929, and October 29, 1929. There is very little change in the lung fields, except that the lower lobes appear clearer, with less evidence of congestion. Findings do not indicate pneumonia. (NOTE.—X ray of October 26, 1929, was not reported separately.)

*Faecal cultures.*—Negative for typhoid—dysentery group. No parasites or ova.

*Blood Kahn.*—Negative.

*Blood cultures.*—The first (taken November 1, 1929) of a series of blood cultures was positive for *B. typhosus*. The other two cultures were negative. Organism identified by morphological, cultural, and serological studies. Agglutinated in d.l. of 1-10,280 with *B. typhosus* agglutinating antiserum (Mulford).

*Widal tests.*—Several negative Widal tests were obtained, using the stock formalinized antigens supplied to us.

The following experimental and comparative agglutination tests were done (the tests were macroscopic, placed in water bath at 37° C. for two hours, and then in refrigerator over night):

November 11, 1929.—

Rack No. 1: Patient's serum+stock formalinized antigen=negative all dilutions.

Rack No. 2: Mulford *B. typhosus* agglutinating antiserum+stock formalinized antigen=*B. typhosus* agglutinated in dil. 1-2,560; para A agglutinated in dil. 1-5,120; para B agglutinated in dil. 1-1,240.

Rack No. 3: Patient's serum+isolated organisms (formalinized)=agglutination in dil. 1-160.

Rack No. 4: Mulford agglutinating antisera+isolated organism (formalinized)=*B. typhosus* antiserum agglutinated organism in dil. 1-10,240; para A antiserum agglutinated organism in dil. 1-40; para B antiserum—no agglutination.

November 24, 1929.—Patient's serum agglutinated isolated organism as follows:

Rack No. 1: Patient's serum+ formalinized isolated organism=agglutination in dil. 1-160.

Rack No. 2: Patient's serum+20 hr. living bouillon culture=agglutination in dil. 1-1,280.

#### DISCUSSION

The cases cited above illustrate some of the clinical and laboratory problems in making a diagnosis of typhoid fever. It would have been easy in case No. 1 to consider the case as one of sepsis and to

neglect the proper laboratory procedures. The white blood count alone in this case should have spoken against sepsis or a meningitis; yet the patient's condition so closely simulated one or both of these conditions that blood cultures and a spinal puncture were done. While the blood culture led to the proper diagnosis, typhoid fever was not suspected at the time. Had the first blood culture been long deferred or had the customary Widal been relied upon, the proper diagnosis would not have been made with certainty.

Case No. 2 shows the importance of thinking of typhoid fever as a possibility, since the diagnosis of pyelitis had already been made, and not without reason. It also shows that one should not forget typhoid as a possibility after one negative blood culture, for it was a positive fecal culture and later a positive Widal that confirmed the diagnosis here, although the clinical course was fairly typical. The rose spots, however, were extremely suggestive, but it is easy to overlook rose spots on navy personnel who have all had one or more courses of typhoid prophylaxis.

Just where these two patients contracted the disease is problematical, but it is possible that case No. 1 contracted the disease ashore and that case No. 2, being a laundryman, contracted the disease by handling the former's clothes.

Case No. 3 was a typical one of typhoid fever throughout its course. Typhoid fever, however, was not suspected until rose spots appeared. As doubtless often happens, perhaps several reasons account for this. In this particular case the cerebral symptoms were at first pronounced and were considered sufficient to indicate a spinal puncture. Also the pulmonary symptoms were pronounced at first, and a bedside X ray was suggestive of pneumonia. It would have been easy to consider this a case of pneumonia, with a suggestive X ray to substantiate the diagnosis, and to neglect other procedures which would have made the real diagnosis. Yet it is well known that typhoid fever may have marked pulmonary or meningeal manifestations. In the beginning the leucocyte count threw doubt on a diagnosis of pneumonia or of meningitis. The rose spots then developed and suggested the proper procedures.

It would seem needless to remark that, in suspected typhoid fever, the important laboratory procedures are cultures and Widal tests. The blood culture is of prime importance, should be done early (before the tenth day of the disease), and several should be made. If these are negative, fecal and urinary cultures should also be made. Having thus far failed, the Widal test is then to be considered of paramount importance in making a laboratory diagnosis.

It has been customary to use prepared antigens (killed cultures of *B. typhosus*, para A, and para B) in the Widal reaction. I am of the opinion that such antigens are unreliable in the diagnosis of

typhoid fever unless they are less than 3 months old. Even then they are inferior to living 18-hour broth cultures. It will be noted that killing the typhoid bacillus by heat will destroy its agglutinability, as shown in case No. 2. This fact was demonstrated by Eisenberg and Volk in 1903. So it is now customary to use formalinized cultures as antigens in the Widal test. Even these antigens, however, are not as agglutinable, even when fresh, as are the living broth cultures. This is demonstrated in case No. 3. In all three cases cited a regular macroscopic Widal was done, using the prepared antigens furnished us. These antigens were 9 months to over a year old, but were recently issued. All Widal tests done with these antigens were negative, while positive results were obtained with the living cultures. Using a known agglutinating serum of high titer, the prepared antigens will agglutinate, but in practice we use the patient's blood serum, which has not had time to develop marked agglutinative power until perhaps late in the course of the disease. This very fact makes these prepared stock antigens, in my opinion, worthless. In all three cases the positive Widal's of significance were obtained with living cultures only. Had we depended upon the stock antigens alone, the diagnosis of typhoid fever would not have been made.

To do a series of Widal tests is of importance when the patient has previously received typhoid prophylaxis, for one can never tell with a single Widal of low titer just how much of the agglutination is due to previous inoculation and how much is due to the presence of typhoid fever. To do such a series of Widal's on a typhoid patient should show a stronger and stronger reaction as the antibodies continue to increase in the patient's blood.

#### CONCLUSIONS

1. Typhoid prophylaxis does not render 100 per cent immunity against typhoid fever.
2. It is believed that more diagnoses of typhoid fever will be made if we continue to consider this disease as a possibility in our differential diagnosis.
3. As is well known, early and repeated blood cultures are the most important laboratory procedures in the diagnosis of typhoid fever.
4. The Widal test should be macroscopic and done with fresh, living, bouillon cultures. Prepared stock antigens are not reliable, except perhaps very late in the course of the disease. For this test it is better to keep on hand living cultures of *B. typhosus*, para A, and para B, and to make fresh bouillon subcultures as necessary for the test. The organisms must be those known to agglutinate well by actual trial.



**MENINGOCOCCEMIA FOLLOWED BY CEREBROSPINAL FEVER<sup>1</sup>**

By V. B. RIDEN, Lieutenant, Medical Corps, United States Navy

Meningococci invade the blood stream usually from the upper respiratory passages. From the blood stream they enter the meninges, producing cerebrospinal fever.

The blood-stream infection precedes cerebrospinal fever by a period of hours, days, or even weeks, presenting a typical picture of septicemia; upper respiratory infection, the characteristic hebetude; cyanosis, or ashen color of skin; usually only a moderate irregular fever; arthralgia, marked polymorphonuclear leucocytosis; exaggerated, often ill balanced, reflex activity; positive bacteriologic findings in tonsils, nasopharynx or blood stream; and the expected but not constant later development of the typical meningitis.

Neal, Jackson, and Appelbaum, reporting 654 cases of epidemic meningitis in New York, make the following statement concerning the septicemic type of meningitis:

This type is rare among sporadic cases. In certain army camps during the war there was a very large percentage of this type of case. The early picture is that of septicemia, rather than that of meningitis, the meningeal symptoms developing five or six days or more after the onset. A profuse and rapidly spreading macular or purpuric rash is an almost constant feature and usually persists for some time. Other indications are those of generalized blood-stream infection, such as joint involvements, which may be present even before meningeal symptoms.

Dr. T. W. Morlau, of Boston, in the *Journal of the American Medical Association* of February 23, 1929, page 619, reports a case of meningococemia and reviews the American literature to date. According to his article, only 13 cases have been published, while foreign literature contains approximately 110 cases. Dack, in 1924, believed the wide difference was due to lack of knowledge of the disease rather than to greater frequency of the condition abroad.

There are varying reports as to treatment. Some good results were obtained by specific treatment; other reports were far from satisfactory.

The report of the following case, which was treated in the medical service of the United States Naval Hospital, Mare Island, Calif., is of interest:

J. G., coxswain, United States Navy; admitted to hospital January 18, 1929. Diagnosis is undetermined (tuberculosis, pulmonary), complaining of loss of weight, cold, pain in muscles of both legs. The family history had no bearing on the case.

*Past history.*—Influenza, 1918; chancroidal lesions in 1924, 1926, and 1928. Habits are normal.

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<sup>1</sup> Read before the August, 1929, staff meeting of the U. S. Naval Hospital, Mare Island, Calif.

**Present illness.**—He was exposed to tuberculosis in the sick bay of his ship in December, 1928. On December 19, 1928, patient went to sleep on the deck in one of the compartments of his ship. He awoke feeling ill; on reporting to sick bay he had a fever of 101. He was admitted and kept in bed for three days, treated for influenza. When allowed to be up and around he had severe muscular pains in the calves and thighs of both legs. He complained of hard, raised, reddened spots about the size of thumbnail, that were very painful and sore for three or four days, after which they would disappear. These spots continued to come and go. He lost weight. There was morning cough, but no sputum. There was no history of blood spitting, no pain or soreness in chest, but there were occasional night sweats.

**Examination.**—Age, 23; normal weight, 165 to 170 pounds; 69 inches high. Shows evidence of about 25 pounds loss in weight. The physical findings were negative except for impaired percussion note, an occasional moist r le and slight increase in whispered voice in right axilla, and a scattered rash over trunk and extremities. The deep reflexes were exaggerated. Romberg negative. The inguinal glands enlarged.

Conclusion arrived at from physical examination was possible syphilis.

January 24, 1929. Temperature rose to 103 daily, falling to subnormal during night. He was feeling well in the morning, but as temperature rose he would feel worse. The Kahn test was negative. X ray of chest was negative, and there was apparently no liver enlargement. Blood smear for malaria was negative and all sputum examinations were negative for acid-fast bacilli. The R. B. C. was 4,980,000; W. B. C., 22,375; hemoglobin, 80 per cent; polynuclears, 70; lymphocytes, 27; transitionals, 3. Blood culture made.

January 28, 1929. No report on culture. Condition remained about the same. Sputum negative.

January 30, 1929. Laboratory reports blood culture positive for meningococci. Malarial smears negative. Laboratory wished to take another blood culture to confirm previous findings. The skin reaction to antimeningococcic serum was positive.

January 31, 1929. Desensitization.

9.30 a. m., 0.2 c. c. antimeningococcic serum, subcutaneously.

10.00 a. m., 0.4 c. c. antimeningococcic serum, subcutaneously.

10.30 a. m., 0.6 c. c. antimeningococcic serum, subcutaneously.

11.00 a. m., 0.8 c. c. antimeningococcic serum, subcutaneously.

11.30 a. m., 1 c. c. antimeningococcic serum, subcutaneously.

1.15 p. m., 5 c. c. antimeningococcic serum, subcutaneously.

2.15 p. m., 10 c. c. antimeningococcic serum, subcutaneously.

No reaction.—

February 1, 1929. 25 c. c. antimeningococcic serum given intravenously. Patient showed signs of reaction during injection and it was discontinued immediately. Given  $\frac{1}{2}$  c. c. of adrenalin. Reaction symptoms disappeared shortly. Temperature rose to 100.

February 2, 1929. 25 c. c. antimeningococcic serum intravenously. Temperature rose to 103°.

February 4, 1929. Second blood culture was positive for meningococcus. Diagnosis changed to septicemia. Atropine grs. 0.01 hypo, followed one half hour later by 30 c. c. of antimeningococcic serum intravenously. No reaction. Temperature normal.

February 6, 1929. The pulse has fluctuated from 80 to 100 all during the disease. Temperature rose to 102 last night. There is reddening of skin over site of subcutaneous injections of serum, and a few urticarial wheels noticed.

February 9, 1929. Patient has a severe headache. Since he had been suffering from serum sickness for past few days, this was thought to be cause of headache. During afternoon he developed some soreness and stiffness of neck. Kernig's sign positive.

8.30 p. m. given 0.01 gr. atropine sulphate. Spinal puncture under local anesthesia; 35 c. c. turbid fluid withdrawn; 27 c. c. antimeningococcic serum intraspinaly by gravity. Spinal fluid was under pressure. Fluid cell count, 4,399.

February 10, 1929. 4 a. m., pulse irregular. Nausea and vomiting; 35 c. c. turbid fluid removed, fluid under pressure; 27 c. c. antimeningococcic serum intraspinaly. Condition not very good. 12 noon, severe headache. Morphine gr.  $\frac{1}{4}$  given. Pulse slow and irregular. Adrenalin 1 c. c. hypo. 1.30 p. m., digitalin 0.01 gr. hypo. Perspired freely. Temperature, 100.2°. Culture spinal fluid positive for meningococcus. 8 p. m., atropine gr. 0.01; spinal puncture, fluid under pressure, 40 c. c. removed; 30 c. c. antimeningococcic serum intraspinaly. Vomiting bile frequently; 500 c. c. of 5 per cent glucose in normal saline given. Pulse good. Cell count on the two punctures was 3,381 and 4,441. He had a very restless night. Neck stiff and sore. Babinski and Kernig signs positive.

February 11, 1929. 9 a. m., delirious at times during night. Atropine gr. 0.01; spinal puncture, fluid under pressure; 45 c. c. withdrawn and 30 c. c. serum injected; 300 c. c. glucose and saline given intravenously.

11.30 a. m., severe chill, controlled by 1 c. c. adrenalin and heat. Temperature rose to 101.6°; pulse, 65.

5.30 p. m., atropine gr. 0.01; spinal puncture, fluid under slight pressure; 35 c. c. withdrawn; 15 c. c. serum intraspinaly; still vomiting bile. Cell count, 4,704. Blood culture 8 days old shows no growth.

February 12, 1929. Atropine gr. 0.01; spinal puncture, fluid under moderate pressure; 40 c. c. of yellow tinged fluid withdrawn; 15 c. c. serum intraspinaly. Temperature rose to 99.8°. No vomiting; taking nourishment.

8 p. m. atropine gr. 0.01; spinal puncture; 35 c. c. fluid withdrawn; 25 c. c. serum intraspinaly. Cell count, 4,450.

February 13, 1929. 9.30 a. m., patient's condition not very good. Temperature normal; pulse, 65. Atropine gr. 1/100; spinal puncture, fluid under pressure; 50 c. c. removed; 30 c. c. serum given.

5.30 p. m., atropine gr. 1/100; spinal puncture; 50 c. c. fluid under pressure removed; 30 c. c. serum intraspinaly. Taking nourishment. No vomiting, but does not look very good. Temperature, 100.4°; cell count, 3,550.

February 14, 1929. Somewhat brighter. Pulse good; taking nourishment. Spinal puncture, 40 c. c. straw-colored fluid removed. No serum given. Cell count, 8,052.

February 15, 1929. Brighter, improving. Spinal puncture, 35 c. c. slightly cloudy fluid removed. Cell count, 1,024.

February 16, 1929. Spinal puncture, 25 c. c. fluid withdrawn; slight yellow tinge; cell count, 683.

Improvement continued until he is now up and around and feeling well.

#### SUMMARY

Infection of blood stream occurred December 19, 1928, or soon thereafter, and meningitis developed February 9, 1929, a period of approximately seven weeks.

Meningitis developed five days after the third intravenous injection of antimeningococcic serum and after the blood stream had been rendered negative for meningococcic infection.

## CONCLUSIONS

1. The symptoms of the blood-stream infection are quite typical, but the condition rarely advances to this stage, and few cases are recognized on the symptoms alone.

2. Treatment of meningococcic blood-stream infection by small intravenous injections of antimeningococcic serum will apparently rid the blood stream of infection, but seems to have little effect on the prevention of cerebrospinal fever.

3. Large doses of serum intravenously might have prevented cerebrospinal fever, but this is doubtful.

4. It seems that intraspinal preventive treatment during blood-stream infection would be the proper treatment, although there is no doubt that withdrawal of fluid from spinal canal would increase the chances of migration of the meningococcus from the blood stream to the meninges. Nevertheless, a vast majority of the blood-stream infections are followed by cerebrospinal fever, and any treatment that would decrease the percentage of cases following blood-stream infection would certainly be worth while.

5. Atropine, gr. 1/100, has a tendency to ward off reaction, and its use 15 to 30 minutes before serum injection is recommended in both blood-stream and meningeal infection.

6. Adrenalin, generally believed to be contraindicated in cerebrospinal fever, was given twice during meningeal infection with no ill effects.

7. Failure in specific treatment should be checked by agglutination test to see if the polyvalent serum carries the particular strain concerned.

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**ANALYSIS OF EIGHTEEN FATAL CASES OF CEREBROSPINAL FEVER**

By P. F. DICKENS, Lieutenant, Medical Corps, United States Navy

All deaths due to cerebrospinal fever which occurred in the Navy during 1929 have been reviewed in detail.

Before discussing the analysis it seems well to first review the clinical picture of the disease.

*Definition.*—Cerebrospinal fever is a communicable disease due to a gram negative diplococcus, the *Diplococcus intracellularis*. It is characterized by a gradual invasion of the body as follows: (a) Local involvement of the upper respiratory tract; (b) general invasion of the blood stream; (c) localization, usually in the meninges, but not infrequently in joints, lung, or heart.

The symptoms appear in three stages: (1) Those due to local infection of the upper air passages, (2) those due to general invasion of the blood stream, and (3) those due to localization. The

symptoms in the first stage are those of an infection of the upper air passages such as tonsillitis, pharyngitis, etc. This is ordinarily known as the carrier stage. In the second stage, or blood-stream invasion, the patient is dull, apathetic, and resents disturbance; the average temperature is not high, about 101° F.; chill is frequent; and there is a complaint of "being sore all over the body"; deep reflexes are exaggerated and hyperesthesia is present. The most distinctive and possibly pathognomonic sign in this stage, however, is the rash. All the above signs and symptoms occur during the blood-stream invasion and are generally present when the third stage makes its appearance. The third or meningeal stage is ushered in with (1) headache, (2) vomiting, (3) stiffness of the neck, (4) positive Kernig's or Brudzinski's sign, (5) chilly sensations to frank chill, and (6) a relatively slow pulse often with irregularities. With increased intracranial pressure, Cheyne-Stokes, or Biot's type of respiration may appear. Insomnia, delirium, or coma occur often.

The following laboratory findings are considered quite characteristic: A leukocytosis is present in all three of the above stages, the white blood cell count ordinarily ranges from 15,000 to 40,000 or more; a high polymorphonucleosis is most significant; a positive blood culture may be obtained in 80 per cent of the cases if careful technique is employed; the cerebrospinal fluid may be normal on the first puncture and may remain normal for weeks or throughout the course of the disease in those cases in which the infection does not localize in the meninges; when the meninges are invaded, an increase in the globulin content of the cerebrospinal fluid is probably the first abnormality to occur. Generally, however, the microorganism may be found both by smear and culture. This is followed by an increase in the cell count, particularly of the polymorphonuclear cells in the cerebrospinal fluid, and later by a diminution in the sugar content of that fluid. In connection with the symptoms mentioned above, attention is invited to Table No. 1, in which it may be noted that the presenting symptoms correspond to those ushering in during the third stage of the disease.

TABLE 1.—*Frequency of presenting symptom*

Headache.....	14
Stiff neck.....	12
Kernig.....	12
Brudzinski.....	4
Coma.....	3
Delirium.....	2
Rash.....	10
Vomiting (before admission or in first 24 hours).....	12

From the above table it will be noted that definite signs and symptoms denoting meningeal involvement were present. Ten of these patients also exhibited a rash characteristic of blood-stream infection. Most of the patients showed meningeal involvement at the time the rash was discovered. This would seem to indicate a rather rapid invasion of the meninges by the infecting microorganism.

Taking the above as a starting point, an attempt was made to determine the cause of death in a disease for which we have a specific serum. It was deemed advisable to ascertain first the difficulties encountered in establishing the diagnosis and, if possible, to bring to light reasons for erroneous diagnosis, thereby causing a delay in administering specific treatment. In this connection the records show that the fatal cases of cerebrospinal fever were originally admitted to the sick list and transferred to hospital or hospital ship with the following diagnoses:

TABLE 2

1. Encephalitis.
2. Influenza.
3. Undetermined (cerebrospinal fever).
4. Undetermined (cerebrospinal fever).
5. Undetermined (cerebrospinal fever).
6. Catarrhal fever.
7. Cerebrospinal fever.
8. Diabetes mellitus.
9. Cerebrospinal fever.
10. Catarrhal fever, acute.
11. Blackwater fever.
12. Catarrhal fever, acute.
13. Cerebrospinal fever (autopsy).
14. Cerebrospinal fever.
15. Cerebrospinal fever.
16. Malaria.
17. Undetermined (cerebrospinal fever).
18. Cerebrospinal fever. (Diagnosis made in civilian hospital, China. Case not under care of naval medical officer.)

## RECAPITULATION

Diagnosed as cerebrospinal fever.....	8
Catarrhal fever, acute.....	3
Encephalitis.....	1
Diabetes mellitus.....	1
Malaria.....	1
Blackwater fever.....	1
Diagnosed at autopsy.....	1
Insufficient data for diagnosis.....	1

Table 2 shows that in 8 cases the disease was diagnosed upon original admission or was suspected as being present and diagnosed as "Diagnosis undetermined (cerebrospinal fever)." The 10 remaining cases received various diagnoses ranging from blackwater

fever to diabetes mellitus. The diagnosis upon original admission in cases Nos. 1, 8, 10, 11, and 16 are reviewed in detail.

The evidence available as recorded in the health record shows marked inconstancy in the physical findings, but indicates fairly constant findings in regard to presenting symptoms. For instance, most health records show entries made both aboard ship and at hospital that the patient was admitted to the sick list complaining of headache, vomiting, and "feeling sore all over." The health records also agreed on such findings as leukocytosis, increase in the percentage of polymorphonuclear leukocytes, temperature, and pulse rate. The main disagreement in the health records was as follows: On board ship no mention would be made of positive Kernig's sign, stiff neck, or a rash, while the records showed that these symptoms were present on admission to hospital. This would seem to indicate that a more careful physical examination is conducted at hospitals than on board naval vessels, or that the signs did not appear until after the patients had arrived at the hospitals.

The details in cases Nos. 1, 8, 10, 11, and 16, as taken from the health records, are as follows:

**Case No. 1:** Admitted April 28, 1929, with diagnosis undetermined (encephalitis). Presenting symptoms were headache, lethargy, nausea, and vomiting. This statement appears in the health record: "Beyond apparent suffering from a severe headache there was nothing unusual about this case. This afternoon, however, his headache increased; there was some twitching of facial muscles, and he was not keenly aware of his surroundings." The white blood cell count was 29,300, with 90 per cent polymorphonuclear leukocytes. The medical officer states that it is his impression that the patient is suffering from "a severely toxic infection either of the cerebrum or blood stream." Transferred to hospital April 29, or on the day after admission, where the following findings were added to those noted above: "Rigidity of neck and a positive Kernig. An immediate lumbar puncture gave the following information: Normal pressure and clear, but a smear made from the cerebrospinal fluid showed many gram negative intracellular diplococci."

**Case No. 8:** The patient was admitted January 20, 1929, with diabetes mellitus, complaining of headache, aching in joints and over body for the past two or three days. It was mentioned that he was irrational and lethargic. The white blood cell count made aboard ship in this case was 23,500, with 93 per cent polymorphonuclear leukocytes. The temperature was 102° F. He was treated for diabetes on board ship during the day and night of admission and transferred to hospital ship the next day, where the following information was obtained: Patient was unconscious and had positive Kernig's and Brudzinski's signs, exaggerated reflexes, and urine negative for sugar (ship reported urine positive for sugar). An immediate spinal puncture revealed the following and established the diagnosis: Fluid under pressure and smear positive for gram negative intracellular diplococci.

**Case No. 10:** Admitted February 2, 1929, with acute catarrhal fever. The following is quoted from the health record: "The boatswain's mate reported that there was a man sick down in the bag alley. When brought to the sick bay and put to bed he complained of pains over spine and lower region of back. Headache and temperature 102° F. Face flushed." A letter from the com-

manding officer of the ship contains the following statement: "As this man became ill in the forenoon of February 2, 1929, he was transferred at once to the naval hospital \* \* \* and the hospital was notified that he was one of a draft which had been received from Newport, R. I., 11 days previous, and that the medical officer at Newport had notified us that this draft had been exposed to cerebrospinal fever." On admission to hospital the following entry was made in the health record: "Complaining of pain in back, legs, and headache. Onset sudden and severe enough to double patient up and make walking impossible. Physical examination \* \* \* tenderness, lumbosacral region. Legs spastic—absence of voluntary movements. Hyperactive reflexes, left leg. February 9, 1929, temperature normal since February 3. February 3, 1929, spinal fluid examination normal. February 19, 1929, temperature 102° to 103° since February 10, 1929. Headache more severe, projectile vomiting. Blood culture showed gram negative cocci and diplococci. Blood count: W. B. C., 14,500; polymorphonuclears, 90 per cent. Spinal fluid examination: Cloudy; pressure, 17 m. m. gram negative diplococci-meningococcus-cell count, 1,764; many pus cells." Serum administered this date. Nurse's bedside notes: "Rash on body (scabies?), vomiting. Legs are stiff." This note under date of February 14, 1929.

Case No. 11: Admitted March 7, 1929, from the same ship as case No. 10. Admission diagnosis—blackwater fever. Presenting symptoms were projectile vomiting, severe headache, pains over body, and sore throat. White blood cell count was 20,400, with 90 per cent polymorphonuclear leukocytes, and temperature 100° F. The following statement appears in the health record: "The last smear taken at 12.30 p. m. shows many distorted red blood cells and many merozoites between the red cells." A previous entry is as follows: "Blood smear showed a large number of malarial parasites; white blood count, 20,400." Urinalysis was recorded as follows: Voided 675 c. c. heavy trace of albumin; specific gravity, 1.035; dark amber color; benzidin test positive for blood, semi-granular, hyaline casts, and pus cells present. Transferred to hospital ship the day after admission. The following entry appears: "On admission at 8.30 p. m. this date patient is in a wildly delirious state; physical examination marked rigidity of neck and a positive Kernig. Petechial spots about body, no abnormal reflexes \* \* \*; white blood count, 23,400; polys, 90 per cent, negative for malaria. Urine amber, clear; specific gravity, 1.024; albumin present; numerous granular casts. Lumbar puncture, 40 c. c. of a cloudy fluid removed which showed a cell count of 2,850 and smears showed many gram negative intra and extra cellular diplococci." The erroneous diagnosis in this case caused a delay of 36 hours in the administration of specific treatment. This case appeared on board a ship where a fatal case had developed about one month previously.

Case No. 16: Admitted May 25, 1929, with diagnosis of malaria. Patient had arrived in the Tropics one month previously on a transport on board which several cases of cerebrospinal fever had occurred en route from an east coast port of the United States. The entry in the health record upon admission is as follows: "Typical paroxysm of chill and rise in temperature." Transferred to hospital the same day. The following entry was made after arrival at hospital: "Patient admitted with temperature of 101° F.; states that he has been sick for about five days; that malaria was found in his blood \* \* \*; smear positive for benign tertian here. Quinine therapy. May 27, 1929, patient acts confused, falls out of bed, reacts to questions slowly, and has difficulty in articulation. There is some rigidity of neck muscles and a positive Kernig. White blood cells 9,400; polys, 74 per cent. Spinal puncture



shows spinal fluid under pressure \* \* \*. Microscopic examination shows many pus cells and gram negative intra and extra cellular diplococci."

The diagnosis in this case was rendered difficult due to the fact that the patient undoubtedly had simultaneous attacks of malaria and cerebrospinal fever. One can not overemphasize the importance of the fact that the practice of medicine is rendered difficult in the Tropics. This is due to the multiplicity of diseases which may be found on admission to the sick list. It takes an acute mind to select and treat the disease responsible for the existing disability.

Three tables (3, 4, and 5) have been prepared, showing the number of cases in which involvement of the upper respiratory passages was observed, the initial temperature and pulse rate, and the white blood cell count, and per cent of polymorphonuclear leukocytes.

It will be noted that Tables 3 and 4 agree with the diagnostic picture given at the beginning of the study. Table 5 is the most interesting and shows a significant finding not hitherto given sufficient weight; this is, the enormous increase in the percentage of the polymorphonuclear leukocytes, regardless of the total number of white blood cells. If a differential blood cell count was made in cases 9, 13, and 15 it was not so stated.

TABLE 3.—Symptoms of upper respiratory tract infection

As upper respiratory tract infection.....	6
As tonsillitis, pharyngitis, etc.....	9
Total.....	15

TABLE 4

Case	Initial temperature	Pulse rate	Case	Initial temperature	Pulse rate	Case	Initial temperature	Pulse rate
1.....	100	88	7.....	102		13.....	104	140
2.....	99	90	8.....	102	110	14.....	101	66
3.....	101	96	9.....	101	112	15.....	104	
4.....	101		10.....	102		16.....	101	
5.....	101		11.....	100		17.....	100	66
6.....	103	140	12.....	103	108	18.....	103	110

TABLE 5

Case	Initial white blood cell count	Poly-morpho-nuclear percentage	Case	Initial white blood cell count	Poly-morpho-nuclear percentage	Case	Initial white blood cell count	Poly-morpho-nuclear percentage
1.....	29,300	89	7.....	40,000	90	13.....	(1)	(1)
2.....	15,000	80	8.....	23,500	93	14.....	25,500	98
3.....	9,300	82	9.....	(1)	(1)	15.....	(1)	(1)
4.....	21,050	87	10.....	14,500	90	16.....	9,400	74
5.....	30,350	95	11.....	23,450	90	17.....	30,060	0
6.....	18,300	89	12.....	11,500	90	18.....	(1)	(1)

(1) No count recorded.

*Spinal puncture.*—It is gratifying to note that there was no hesitancy in performing spinal puncture in the majority of the cases reviewed when such procedure was determined upon. Any delay seemed due to a misinterpretation of the symptom complex. Inserted below is Table 6, which shows the number of days elapsing from the onset of the disease until admission to sick list, first spinal puncture, and administration of the first dose of anti-meningococcus serum. In but two instances was a spinal puncture performed for diagnostic purposes and serum not administered. This is believed to be not a safe practice. In the opinion of the writer, antimeningococcus serum should be administered before the needle is withdrawn in every case exhibiting symptoms suggestive of cerebrospinal fever which warrants spinal puncture for diagnostic purposes.

TABLE 6

Case	Date of onset	Date of admission to sick list	Date of first spinal puncture	Date of first dose of serum	Number of days between date of onset and date of intraspinal injection	Number of days from admission to sick list to death of patient
1.....	Apr. 27, 1929	Apr. 28, 1929	Apr. 29, 1929	Apr. 29, 1929	2	4
2.....	May 13, 1929	May 14, 1929	May 15, 1929	May 15, 1929	2	1
3.....	Dec. 22, 1928	Dec. 25, 1928	Dec. 25, 1928	Dec. 25, 1928	3	1
4.....	Apr. 13, 1929	Apr. 17, 1929	Apr. 17, 1929	Apr. 17, 1929	4	1
5.....	July 11, 1929	July 12, 1929	July 12, 1929	July 12, 1929	1	31
6.....	Jan. 15, 1929	Jan. 16, 1929	Jan. 17, 1929	Jan. 17, 1929	2	3
7.....	May 22, 1929	May 22, 1929	May 23, 1929	May 23, 1929	1	2
8.....	Jan. 17, 1929	Jan. 20, 1929	Jan. 21, 1929	Jan. 21, 1929	4	1
9.....	Apr. 21, 1929	Apr. 22, 1929	Apr. 24, 1929	Apr. 24, 1929	3	2
10.....	Feb. 1, 1929	Feb. 2, 1929	Feb. 3, 1929	Feb. 19, 1929	18	25
11.....	Mar. 6, 1929	Mar. 7, 1929	Mar. 8, 1929	Mar. 8, 1929	2	4
12.....	Mar. 8, 1929	Mar. 10, 1929	Mar. 11, 1929	Mar. 11, 1929	3	1
13.....	Apr. 4, 1929	-----	-----	-----	-----	0
14.....	Apr. 3, 1929	Apr. 7, 1929	Apr. 7, 1929	Apr. 7, 1929	4	12
15.....	Apr. 15, 1929	Apr. 15, 1929	Apr. 15, 1929	Apr. 15, 1929	0	1
16.....	May 20, 1929	May 25, 1929	May 27, 1929	May 27, 1929	7	11
17.....	July 22, 1929	July 22, 1929	July 23, 1929	July 23, 1929	1	1
18.....	July 14, 1929	July 15, 1929	July 17, 1929	July 17, 1929	3	4

The date of onset in the above table is taken from information obtained from bedside charts or from the health record. The date of admission to sick list is original admission at the point of origin of the case and not to hospital. The date of first spinal puncture and first dose of serum are taken from the health record. The number of days between date of onset and date of intraspinal injection and number of days between date of admission to sick list to date of death are important factors in determining the type of the disease and usefulness of serum. Case No. 4 is interesting due to the fact that he was taken sick at his home while on liberty and was treated by a "cultist" (chiropractor) for stiffness of the neck and headache. The "cultist" treated the patient on three successive

days by manipulation of the neck. The patient returned to his station with a cutaneous rash in full bloom, a positive Kernig's sign, and otherwise presenting symptoms of a typical case of cerebrospinal fever. It may be stated that he returned to his station by riding on a street car through a large city, thereby undoubtedly subjecting many to possible infection. His disease was recognized immediately upon his arrival, spinal puncture was at once performed, diagnosis established, and serum administered, but in spite of all this the patient died the following day. Case No. 5 presents interesting facts from another angle. Having been admitted with headache, rash, a white blood cell count of 30,350, with 95 per cent of polymorphonuclear leukocytes, spinal puncture was performed and anti-meningococcus serum administered. The cerebrospinal fluid was reported as normal and smear and culture negative. On the following day the medical officer noted that the rash was fading. His impression, as recorded on bedside notes at this time, was that the rash was erythema multiforme and, therefore, no serum was given on this or the following day. The next day headache had increased and the rash reappeared. A second spinal puncture was performed and a gram negative intracellular diplococcus found in the cerebrospinal fluid. The first spinal puncture was probably performed during the blood-stream invasion and before meningeal involvement. A blood culture would have probably settled the question. Serum therapy was again resumed and continued daily for four days, omitted for one day, then the sixth spinal puncture was performed and serum administered. Two days were allowed to elapse before the seventh puncture and the administration of serum. Following this, seven days were permitted to elapse before the eighth puncture. The ninth and tenth punctures were made on succeeding days, when seven more days supervened before the eleventh puncture. The patient at this point exhibited marked cerebral involvement, with symptoms of cerebrospinal block. The twelfth and thirteenth punctures with administration of serum were then made on succeeding days. The patient died on the day of the thirteenth puncture. It is noted that this patient lived 31 days from the date of onset and that serum was discontinued for varying periods of time after each marked improvement. At no time, however, was the spinal fluid negative for gram negative intracellular diplococci nor had the cell count of the cerebrospinal fluid returned to below 128 per cubic millimeter which was the finding on second spinal puncture. Cultures or smear were found positive on every spinal puncture. The white blood cell counts ranged from 19,500 to 30,350 throughout the course of the disease. The polymorphonuclear cells ranged from 85 to 95 per cent. An enormous amount of laboratory work was per-

formed in this case, including 9 spinal fluid cultures, 8 of which were positive, 11 smears for cerebrospinal fluid, 5 of which were reported positive, and 10 globulin estimations, all of which were reported as showing an increase in this constituent of the cerebrospinal fluid. In addition to having received 13 intrathecal administrations of serum, the patient also received serum intravenously. In connection with this case it is firmly believed that administration of serum should be continued without intermission until the cell count and pressure of the cerebrospinal fluid returns to normal and smears and cultures are negative.

Case No. 10 is reviewed in detail above under diagnosis and is mentioned here simply to show that 18 days elapsed before specific treatment was instituted. In a few instances the medical officer discontinued serum therapy because of serum reaction (serum sickness). In regard to the administration of serum it is believed desirable to indoctrinate medical officers of the Navy with the present view that death resulting from serum administration is rarely, if ever, due to the second or subsequent injections, regardless of the length of time elapsing between doses. In cases where serum causes death it does so on the *first* injection. This applies to all sera. While serum sickness may be expected and generally does occur following the second or subsequent doses, it never results in death. Therefore, serum sickness should never prevent the continuation of specific serum treatment of diseases in which serum is used as a prophylactic or curative agent.

Case No. 13. While the rash was present at the time of admission, the case was fulminating in type and the patient died the same day. The diagnosis was established only at autopsy.

Case No. 18. The disease developed while the patient was on board a small ship to which no medical officer was attached and he was accordingly transferred to a civil hospital where the diagnosis was established.

In regard to spinal puncture, the following pertinent information is abstracted from a recent sanitary report: "In connection with this epidemic it was interesting to note the variance in ideas and treatment by different medical men; four nationalities were represented and each had a different method of treatment and use of the serum; spinal puncture was delayed by the English and French; the Japanese were very slow about puncture and rarely successful, using a general anesthetic, and then failing to enter the canal. There were numerous incidents of reaction from serum, due, in the majority of cases, it was thought, to combined intraspinal and intramuscular injection; several cases of marked numbness of lower extremities

almost to anesthesia, due, it is believed, to excess of preservative in the serum."

*Blood culture.*—While cerebrospinal fever is at present recognized as primarily a blood-stream infection, cultures from the blood were noted but three times in as many different cases and all three were reported as positive. It is believed that sufficient importance is not generally given to this method of diagnosis. In any case of suspected cerebrospinal fever or other blood-stream infection repeated daily blood cultures should be made.

*Carrier stage.*—(Upper respiratory tract infection.) In no instance was the diagnosis made during this stage. No record was found of any attempt to isolate the microorganism from the nose and throat. The fact that the diagnosis was not made during this stage is in accord with practice in civil life, as recognition at this time is generally missed even in the presence of an epidemic of the disease. Nor do we believe that search for carriers should be instituted in the military service. However, in known contacts the disease may be discovered in this stage.

*Rash.*—The rash is typical and practically pathognomonic. After the first case has occurred all patients subsequently admitted with infection of the upper respiratory tract should be carefully examined for the presence of even a few petechial spots, as this may lead to an early diagnosis.

*Meningeal stage.*—All cases under review seem to have presented signs of meningeal invasion upon admission. As noted above, this stage is ushered in by headache, vomiting, stiffness of the neck, and positive Kernig's or Brudzinski's signs. The slightest stiffness of the neck should lead one to suspect the presence of cerebrospinal fever. The same is true of a case presenting headache with an increase in the number of white blood cells, especially if accompanied by a high percentage of polymorphonuclear leukocytes.

*Spinal fluid.*—The cerebrospinal fluid may be negative and blood culture positive. When the meninges are invaded it is generally possible to recover the specific microorganism either by culture or by smear. Should an increase in the number of polymorphonuclear cells and an increase in the globulin content of the cerebrospinal fluid be found the case should be considered as suspicious of cerebrospinal fever, even though there has been a failure to identify the microorganism in smears and cultures made from fluid obtained on the first spinal puncture. The spinal-fluid pressure is variable, generally only slightly increased, unless the case is fulminating or a delay has occurred in entering the spinal canal. The cerebrospinal fluid sugar estimation is probably the best single prognostic finding.

In one case of those reviewed cerebrospinal fluid sugar was estimated and recorded as 4 mg. per 100 c.c. If the cerebrospinal fluid sugar falls below 20 mg. per 100 c.c. and remains so, the prognosis is generally grave, regardless of other findings.

*Block.*—Cerebrospinal block seemingly occurred in five of the cases reviewed. This is generally a fatal complication and proved so in these cases. Puncture of the cisterna cerebellomedullaris, if performed, was not recorded in a single instance. This procedure is not dangerous or difficult to perform. All the evidence available would indicate that cisternal puncture is no more dangerous nor difficult to perform than lumbar puncture. Every naval hospital and hospital ship should have available a medical officer versed in the technique of this procedure, as it may be of life-saving importance not only in cerebrospinal fever but also in several other conditions. It is the only method by which cerebrospinal fever may be treated when block occurs. The instructor in surgery at the United States Naval Medical School is thoroughly in accord with the above statement.

*Treatment—Intravenous medication.*—The patients in eight of the cases reviewed received from 1 to 4 injections of antimeningococcus serum intravenously. The total amount given by this route varied from 15 to 180 c. c. It is generally conceded that this is the only method of attack in the stage of blood-stream invasion and the dose at the initial injection should range from 50 to 100 c. c. This dose should be repeated every 24, 12, or even 8 hours in accordance with the condition of the patient, and should be continued throughout the course of the disease.

*Treatment—Intrathecal medication.*—In all cases, except the one in which cerebrospinal fever was diagnosed at autopsy, the patients received varying amounts of antimeningococcus serum intraspinally. There were a few instances in which the serum was not given daily nor continued until the cerebrospinal fluid returned to normal. The health record would seem to indicate that the reason for interrupting treatment was fear of death from the serum reactions which prevailed in these cases. Serum sickness in no instance should prevent the administration of specific treatment.

#### CONCLUSIONS

(a) The delay in instituting treatment in several cases was due to the fact that the patient did not report to his medical officer at the onset of his attack.

(b) In a few instances erroneous diagnoses may have been responsible for delay in starting treatment.

(c) Meningeal involvement in all but one case was promptly recognized upon admission to hospital, regardless of the original diagnosis.

(d) The laboratory procedures and results were excellent and in every instance confirmed the diagnosis.

(e) In two cases the cerebrospinal fluid first removed was found negative, but the blood in these cases showed a positive culture for meningococci. Work of this character is to be commended.

(f) The reason that more blood cultures were not made was probably due to the fact that the causative microorganism was recovered from the first cerebrospinal fluid withdrawn.

(g) In all but two cases the white blood cell count showed an increase and there was a high percentage of polymorphonuclear cells.

(h) Symptoms enumerated under meningeal involvement were present in every case.

(i) As all of the cases reviewed were fatal, this may explain the relatively high proportion of those of the fulminating type.

(j) Treatment given in cases other than those of the fulminating type was interrupted for various causes. It seems probable in some instances that continuous treatment would have been productive of better results.

(k) Serum sickness occurred in a few cases, undoubtedly causing the discontinuance of treatment.

(l) The intravenous route was not utilized to the fullest extent consistent with the best results.

(m) Cisternal puncture was not performed with those patients showing evidence of spinal block.

(n) Most of these cases were handled in an excellent and praiseworthy manner. This is especially true after admission to hospital or hospital ship.

(o) A few of the original diagnoses were in error and unsupported by the recorded physical findings.

#### RECOMMENDATIONS

(a) In the treatment of cerebrospinal fever, if the patient does not improve after the second injection of a given serum, treatment should be shifted to serum of another manufacturer. The efficacy of a serum may be tested by its agglutination power against microorganisms recovered from the first culture of either cerebrospinal fluid or blood. A serum which causes agglutination only in a dilution of less than 1-50 is rarely efficacious.

(b) That sera produced by various manufacturers be made available for use at hospitals and on board hospital ships.

(c) Serum sickness should not prevent continued medication in positive cases.

(d) That medical officers be encouraged to perfect themselves in the technique of cisternal puncture.

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### A CASE OF GANGRENOUS STOMATITIS

By W. D. DAVIS, Lieutenant Commander, Medical Corps, United States Navy

Gangrenous stomatitis is a rare disease and is usually reported only in children under very insanitary conditions. This case, which proved to be fatal, was in an adult, male, age 21 years. There was no evidence of insanitary conditions or debilitating disease prior to the development of this condition. The following is a history of the case:

On May 26, 1929, C. F. L., seaman, second class; age 21, was transferred to the U. S. S. *Black Hawk* at Chefoo, China, from the U. S. S. *John D. Ford*, with a diagnosis of ulcer of mouth.

*Chief complaint.*—Soreness of left jaw.

*Family history.*—Negative.

*Previous history.*—Usual diseases of childhood, appendectomy four years ago, with normal recovery. Quinsy, left tonsil, four years ago. No headaches, no cough, no gastrointestinal trouble since appendectomy. No history of venereal disease.

*Present illness.*—About five days ago patient says he bit his left cheek while eating. This failed to heal and his jaw became a little sore. A small ulcer appeared where he had bitten his cheek. He was treated for a few days on board the destroyer, but as his temperature remained at 101° he was transferred to the U. S. S. *Black Hawk* for treatment.

Physical examination at that time was as follows: Patient appears slightly pale and somewhat underweight. Left cheek slightly swollen. Pupils equal and react to light and accommodation. Nose and ears negative. Mouth: Ragged grayish ulcer on left cheek; several small ulcers around anterior pillars of tonsils. Neck: No enlargement of glands. Chest: Negative. Abdomen: Soft; spleen not palpable; liver normal in size; no tenderness. Extremities: Negative, Genito urinary: Negative. Temperature, 102.4°; pulse, 105; respiration, 22. Smear from ulcer showed no streptococcus, but was heavily positive for Vincent's spirillum and a fusiform bacillus. Urine: Color amber, clear; specific gravity, 1.020; reaction acid; negative for albumin and sugar and casts. Kahn test negative.

He was given four intravenous injections of neoursphenamine. He was also treated with potassium iodide, local applications of mercurochrome, salvarsan and glycerin, potassium chlorate, hydrogen peroxide, and various other drugs. Continuous hot packs and Dakin's solution were also used.

His temperature ranged from 100° to 103° throughout the disease, with a pulse rate of 80 to 115, except the last few days, when his temperature was 102° to 103°, with pulse rate of 130 to 140.

On June 27 the cheek was swollen and painful. The cheek was incised and a large amount of very foul-smelling necrotic tissue was removed. No free pus was found.





GANGRENOUS STOMATITIS



Gangrenous areas would appear around the incision and slough out. This continued until finally the entire cheek from the zygoma to the lower gums had sloughed. There was never any bleeding.

The lower left teeth became dark and very rough. Neither the submaxillary nor cervical glands ever become involved. There was no evidence of walling off or line of demarcation. The patient became anemic and on June 7 complained of feeling dizzy. He was put on a liver-and-kidney diet and was given iron tonic, and sodium cacodylate injections.

On June 15 his red blood count was 2,440,000; hemoglobin, 60 per cent. On June 29 the count fell to 1,600,000; hemoglobin, 50 per cent, when he was given a blood transfusion of 500 c. c. by the citrate method. The following day the count was 2,060,000; hemoglobin, 60 per cent. On July 6 the red count fell to 1,340,000; hemoglobin, 40 per cent. He was given a transfusion and the following day his blood count was as follows: R. B. C., 1,660,000; W. B. C., 11,000, with lymphocytes 67 per cent; polymorphonuclears, 28 per cent; basophiles, 2 per cent; eosinophiles, 1 per cent; L. mononuclears, 1 per cent; basophilic myelocytes, 1 per cent. Practically all red cells were abnormal forms, of various sizes and shapes, and were deficient in hemoglobin content. The polymorphonuclears were smaller than are usually found.

On June 9 he developed a diarrhea; the stools were watery, and dark in color. He complained of pain in upper left quadrant of abdomen and also over base of left lung. He again became very anemic and his red count dropped to 1,370,000; hemoglobin, 50 per cent, when he was given another blood transfusion. At this time there was evidence of a serofibrinous pleurisy in left chest. The spleen was not palpable.

On July 16 the red count dropped to 900,000, with hemoglobin 40 per cent, when he was again given a blood transfusion. He died the following day at 9.05 a. m.

Four days before he died he complained of defective vision, left eye, saying everything looked blurred.

#### AUTOPSY FINDINGS

Abdomen: There was some free blood present; the omentum was spread over intestines and bound down to intestines by slight adhesions; the large intestine appeared larger than normal, with some narrowing toward the caecum; there was no evidence of ulcerations in intestines or stomach. Spleen: A large well-organized clot of dark blood surrounded the spleen, which was lying detached in the abdomen; the spleen was very friable and not easily differentiated from the organized clot of blood which surrounded it. Liver: Normal in size and appearance; gall bladder distended and soft. Kidney, right: Normal size, capsule strips easily. Left kidney slightly smaller, capsule strips easily; on upper pole of this kidney there was a small abscess which contained a creamy pus. Lungs, right: No gross pathology. Left: Pleural cavity contained about 6 ounces of free yellow fluid; there were light serofibrinous adhesions throughout; in lower lobe pus could be expelled from bronchioles. Heart: Light straw-colored fluid in pericardium; normal in size and no pathological lesions found.

Summary: The points of interest in this case are the slow yet progressive gangrene, with marked anemia. He was sick 58 days. His temperature seldom fell below 100° and usually stayed around 103° F. His white count was 11,000, with only 28 per cent polymorphonuclears and 67 per cent lymphocytes. There was no evidence of nerve involvement, except in the eyes. He suffered very little pain. Smears taken at various times throughout the disease were always heavily positive for Vincent's spirillum and a fusiform bacillus.

## CORONARY DISEASE CAUSING RIGHT HYDROTHORAX

## REPORT OF A CASE

By W. H. FUNK, Lieutenant, Medical Corps, United States Navy

S. H. C.: Age, 65; was admitted to the United States Naval Hospital, Portsmouth, N. H., April 13, 1929. In July, 1928, the patient had an attack of coronary thrombosis, manifested by a gripping viselike pain in the region of the heart which lasted for 24 hours. Hypodermics of morphine gave no relief during this attack. Following this seizure he remained in bed for about a week, but experienced no marked disability until the beginning of the present illness. Several years previously pension examiners had noticed a cardiac irregularity.

In December, 1928, five months after the above-mentioned attack, the patient began to notice shortness of breath on exertion. This gradually progressed until the time of admission, when there was marked dyspnea and orthopnea, with a slight hacking cough but no expectoration. Physical examination showed an old man with a flushed face sitting up in bed, quite dyspneic. Temporal and brachial vessels were tortuous and the radial arteries showed marked sclerosis. The point of maximum impulse was in the fifth interspace within the nipple line. Gallop rhythm was present but no murmurs were heard. Blood pressure was 118/75. The right lung showed the typical signs of fluid from the base to the fourth rib. The left lung was clear except for a few crepitant râles at the base. There was no evidence of ascites or edema. Kahn test was negative. The X ray showed fluid in the right pleural cavity; otherwise the chest plate was negative. The urine showed nothing abnormal.

On day of admission 1,000 c. c. of clear straw-colored fluid with a specific gravity of 1.012 was removed from the right pleural cavity. The low albumin content of this fluid was suggestive of a transudate. The sediment of this fluid showed many small lymphocytes, a few endothelial cells, an occasional polymorphonuclear leucocyte, and was negative for acid fast bacilli. The chest was aspirated five other times at intervals within the next six weeks, withdrawing each time about 1,000 to 1,500 c. c. of fluid showing the above laboratory findings. Marked symptomatic relief was obtained from these aspirations. The gallop rhythm of the heart disappeared following the first aspiration. The patient was up and about the ward and slept without an additional number of pillows. During this time there was an occasional edema of the left leg appearing in the evening and relieved by rest in bed over night.

The patient died suddenly at 5.20 p. m. June 1, 1929 while sitting in the ward playing cards.

Post-mortem examination showed about 1,500 c. c. of straw-colored fluid in the right pleural cavity. The left pleural cavity was normal. The heart showed an area of pericardial adhesions close to the apex of the left ventricle. The ventricular wall below this area of pericardial adhesions was soft, pale in appearance, and the muscle seemed to be replaced by scar tissue. The thickness of the wall at this area was half that of the normal wall. The heart was normal in size, and all valves were normal. Over the left ventricular septum and about the apex of the left ventricle the endocardium was replaced with scar tissue. The lumen of the left coronary artery near the aorta was markedly diminished in size by many sclerotic plaques; the right coronary artery showed an occasional small plaque, but the lumen had not suffered.

Tissue from the wall of the left ventricle was submitted to the United States Naval Medical School, Washington, D. C., and the following pathological report was received.

*Gross examination.*—Specimen consists of two pieces of heart muscle. The endocardium is white and thickened. Myocardium shows white fibrotic areas. Epicardium is white and thickened and shows adherent portions of the pericardium.

*Microscopical.*—Endocardium is thickened and fibrotic. Muscle fibers are granular, stain poorly, and striations are indistinct. Considerable brown atrophy is noted. Large areas of muscle have been replaced by fibrous tissue. These areas show numerous large vessels filled with blood. The epicardium, where the pericardium is adherent, is congested and shows a mild lymphocytic infiltration. These findings are typical of old coronary disease with its infarctions, pericardial adhesions, and areas of fibrosis and muscle degeneration due to lack of nutrition.

*Pathological diagnosis.*—Parenchymatous degeneration and fibrosis, cardiac muscle. Pericarditis, chronic adhesive.

This case is reported as being of unusual interest because of the following: This patient gave a history of recovery from an obvious case of coronary thrombosis in July, 1928. Symptoms due to fluid in the right pleural cavity began about five or six months afterwards and were the only complaint of the patient during his present illness. Cecil says: "In some cases hydrothorax may be due to cardiac insufficiency without coexistent general anasarca. It may be bilateral, but more frequently develops only on the right side, presumably as a result of pressure on the vena azygos major by the dilated right auricle." Feltonhoff and Landis suggest that cardiac hydrothorax may be due to pressure on the pulmonary veins by the dilated portions of the heart. Price suggests that the explanation of hydrothorax is obscure.

**MALARIA TREATMENT OF CEREBROSPINAL LUES****REPORT OF CASES TREATED ABOARD SHIP**

By C. S. STEPHENSON, Lieutenant Commander, Medical Corps, United States Navy, and  
J. LOVE, Lieutenant (Junior Grade), Medical Corps, United States Navy

The value of malaria pyretotherapy first advocated and used by Wagner von Jauregg (1) is no longer of questionable value in the treatment of syphilis of the central nervous system. At first it was used only as a measure of last resort in hopeless paretics, but more recently, due to further clinical study and increasing experience with its use, it has been made to conform to that basic principle of all modern syphilologic regimen, i. e., prompt diagnosis and early intensive treatment. The best results have been obtained in early cases of luetic involvement of the central nervous system, and Bering (2) has even gone so far as to state that malaria treatment is an efficient prophylaxis against central nervous system lues. According to Stokes (3), von Jauregg claims that malaria given to early cerebrospinal luetics will give 100 per cent cures. On the whole, Grinker (4) believes that this form of therapy has awakened hope in our outlook on paresis.

Among our cases was a patient who acquired lues in 1915. His Kahn blood reaction remained 4 plus, despite long and intensive treatment with the arsphenamines and mercury. In common with so many cases of lues of that period he received four injections of salvarsan and some indifferent mercury treatment which produced a negative serology, after which treatment was discontinued. In 1923 he was troubled with severe headaches, insomnia, and general weakness, and his Kahn blood reaction was found to be 4 plus. Since that time he has been on continuous arsenic and mercury therapy, which has kept him symptom free, but has failed to reduce his Kahn blood reaction, and has left him generally weak. In 1928 a course of thio-sulphate seemed to cause an improvement in his general condition and also reduced his Kahn blood reaction to 2 plus.

In view of the long history of lues, it was felt advisable to do a spinal puncture. A 4-plus fluid, strongly positive for albumin and giving a 5555554310-gum mastic curve, was obtained. A complete history, physical and mental examination were done, and except as mentioned above the only positive finding was a readily palpable spleen which could not be accounted for in the past history by malaria, typhoid fever, tuberculosis, or any other disease (except lues) which might cause a splenomegaly. We considered this case as undoubtedly one of paresis sine paresi, and as the spleen appeared to be the main organ affected of the peripheral systems, it seemed that malaria treatment was especially advisable on the

theory that the spleen, if it be the focus of his lues peripherally, would be directly attacked by the plasmodium.

The problem of selecting the correct type of malaria presented itself, as most of our malarias were of the tropical variety. However, by clinical observation and microscopical study of 2-hour smears of patients from whom quinine was temporarily withheld, we obtained a crescent free organism causing a chill every 48 hours and otherwise resembling a benign tertian malaria. During this observed patient's third chill we transferred 5 c. c. of infected blood to our paresis sine paresi patient. The injection was given subcutaneously. The malarial donor was then given quinine, which immediately controlled the malarial process, proving that the strain of plasmodium used was not quinine resistant.

Twelve hours later the paretic patient had a chill and rise of temperature to 102° F. The area of inoculation was tender and the right inguinal glands became acutely enlarged. That this was merely a foreign protein reaction was proved by the fact that it passed away within 24 hours.

The paretic patient remained on duty for one week and claimed that he felt well. Exactly eight days after the inoculation he had a chill and rise of temperature which was followed by sweating and drop of temperature. Twenty-four hours later he had another chill and his temperature rose to 105.2° F. Prior to his second chill physical examination disclosed that the spleen had become smaller than previously, but after the second chill it began to enlarge. The next four chills occurred at 48-hour intervals and each was attended by a fever of 105.6° F. When the fever became unbearable it was found that aspirin in 15-grain doses could be used to induce sweating and lysis of the fever. Codein was also given to relieve the headache and veronal to induce sleep at night, as he was more able to tolerate the fever after a good night's sleep. After this the chills came on more rapidly, occurring approximately at 24-hour intervals.

When the fever (105.6° F.) of his eighth chill began to fall quinine therapy was started, but a chill again occurred on the next day, and the temperature remained at 102.2° F. He had no more chills, and, except for slight nocturnal rises during the next two days, quinine therapy, 15 grains three times a day, controlled the fever.

During this time he was given a daily physical examination and his urine and blood were examined at frequent intervals. His complexion became progressively more anemic and sallow, his general strength waned, and his usual genial disposition disappeared as the chills and fever wracked his body. He lost 12 pounds in weight, his

urine became albuminous, the red blood count fell from 5,230,000 to 3,191,000, hemoglobin from 90 to 60, and the white blood count from 8,000 to 4,400. His spleen became more enlarged, the knee jerks became exaggerated, and a fine tremor appeared.

During convalescence, besides quinine, he was given elixir of iron, quinine and strychnin, and a half pound of liver daily. At first the convalescence was slow and his strength returned slowly. Two weeks after his last chill he went on 10 days' leave and then returned to duty. At present (four months later) he weighs 162 pounds, which is the highest he has reached in five years, and 12 pounds more than he weighed before malarialization. He feels much better, has improved vision, increased strength and working ability, and claims much general improvement. Physically his general appearance is better. The spleen is no longer palpable, his Kahn blood reaction is 2 plus, and his spinal fluid while 4 plus shows only a faint trace of globulin, and gum mastic curve of 4554332100. The latter, however is in no way indicative of his clinical improvement. Serology in these cases is no index of clinical improvement, according to Steel and Nicole (6).

During the course of this case another persistent 4-plus Kahn blood reaction patient requested the treatment. This patient acquired his initial lesion three years before. The diagnosis was not made until the secondary stage had passed and one course of arsenicals was given. Then a year passed without treatment, but since then therapy had been intensive until an arsenical dermatitis appeared. An indolent ulcer developed on the leg and this was aggravated by small doses of salvarsan, so that that form of therapy had to be discontinued. Spinal-fluid examination revealed a 2-plus Kahn reaction, positive globulin, and a 1221000000-gum mastic curve. This fluid and the one mentioned before were checked at the United States Naval Hospital, Canacao, P. I., besides being tested by ourselves on the U. S. S. *Beaver*.

A course of bismuth and, later, thiosulphate failed to improve the serology or the patient's general or local condition. During the preceding patient's eighth chill, 5 c. c. of his blood was taken and injected subcutaneously into the present patient. The same foreign protein reaction mentioned in case 1 occurred 12 hours later and the patient continued on duty for six days, when a chill followed by fever and sweating occurred. The second chill occurred 48 hours later, but the next two chills appeared after 24-hour intervals. The fifth chill occurred after an interval of 48 hours, and at this time a slight icterus appeared. The fever weakened the patient and it was thought advisable to terminate the malaria, but, at the patient's request, he was allowed to have a sixth chill. The jaundice became



so marked that the question of termination was no longer in doubt and quinine by mouth and by vein was given. There was a slight chill and fever the next day, but thereafter convalescence, while somewhat slow, was uneventful. He, too, has more than regained his former weight and strength and blood picture. His spinal fluid after malaria was Kahn 3 plus with a 333222100 curve, but in spite of this, his general condition, strength, and personal sense of well-being have improved to such an extent that he states he would repeat the course if necessary. This patient, however, is a heavy alcoholic and since his recovery has acquired an acute gonococcal infection. The restriction necessitated thereby has permitted a very noticeable improvement and he, too, is 12 pounds heavier than his premalarialization weight.

Both patients have an increased capacity for work and the first patient—a valuable man to the Navy because of his ability and training—is now considering serving 20 years instead of retiring on 16. Certainly he will do so if a follow-up regimen of tryparsamide, bismuth, and reinoculation with malaria, if considered necessary, are successful.

The earlier the diagnosis of central nervous system lues can be made the earlier tryparsamide, or, if practical, pyretotherapy, can be used. Cerebrospinal lues attacks our well-trained personnel who have had years of service and whose usefulness to the service increases with the advancing years. Paresis sine paresi does not always incapacitate a man for duty, but, if untreated, may become frank paresis at any time and carry the patient off within two years after the onset of clinical symptoms.

#### SUMMARY

1. Two cases of cerebrospinal lues were successfully treated with inoculation of malaria on the U. S. S. *Beaver*.
2. Inoculated malaria presents no more difficulties in case management than acquired malaria, except for prolonged observation.
3. Both cases were markedly improved as to general appearance, sense of well-being, physical strength, and mental ability.
4. Both have increased weight and a palpable spleen in case 1 was reduced to an unpalpable size.
5. The immediate effect on the serology (both blood and spinal fluid) in no way measures the clinical improvement, and serology, while of great diagnostic value, is no criterion of prognosis or clinical severity.

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### GONOCOCCUS INFECTION OF A JOINT

By F. R. MOORE, Lieutenant (Junior Grade), Medical Corps, United States Navy

On March 11, 1929, C. J., fireman, third class, United States Navy, aged 25 years, was admitted to the United States Naval Hospital, Canacao, P. I., complaining of a swollen right knee joint, chills and fever, and a urethral discharge. The urethral discharge appeared on March 8, 1929, four days after exposure. The pain and swelling in the right knee joint, accompanied by chills and fever, appeared on March 10, 1929, only two days after the appearance of the urethral discharge.

*Past history.*—Childhood diseases: Measles and chicken pox. Venereal diseases: Previous infection denied. No previous attacks of arthritis or rheumatism.

*Family history.*—Essentially negative.

*Physical examination.*—Young male, aged 25 years, of Italian parentage. Appears to be acutely ill. Temperature, 103.2° F.; pulse, 110; respiration, 20. Head and neck; Eyes—Normal, react to light and distance. Ears—Normal; Mouth—Tongue heavily coated; teeth, numerous pyorrhea pockets; tonsils, atrophic. Nose: Negative. Neck: Negative.

Chest: 1. Lungs: Normal. 2. Heart sounds: Normal. Blood pressure: Systolic, 110; diastolic, 65. Pulse, 110.

Abdomen: Negative.

Genitalia: There is a profuse yellowish urethral discharge. Urine: First glass, heavy cloud, few large shreds; second glass, slight cloud, no shreds; third glass, clear. Later, after washing the anterior urethra, the urine was clear in all glasses. The epididymi and prostate were normal.

Osseous and muscular: The right knee joint is moderately swollen and very tender. Movement of the joint causes the patient severe pain. No fluctuation is noted. No other joints were involved.

Reflexes: Normal.

*Treatment.*—Immobilization of the right knee joint by a posterior leg splint; 10 c.c. of milk intramuscularly every other day; a solution of 1 per cent mercurochrome and 25 per cent glucose, starting at 10 c.c. and increasing gradually, given intravenously every other day; anterior urethral injections of protargol, ½ per cent, twice daily; forced fluids and special soft diet.

*Laboratory reports.*—Kahn: Negative. Urethral smears positive for gonococci. white blood count, 18,200; polymorphonuclears, 86 per cent; lymphocytes, 14 per cent. Stool: Negative for ova and parasites. Urine: Negative, except for numerous pus cells.

**Progress notes.**—March 17, 1929. Temperature, 99°–102° F.; pulse 100. The pain in the knee joint has diminished only slightly. The intramuscular milk injections were discontinued to-day after the fourth injection.

March 20, 1929. Temperature, 99°–101° F.; pulse 96. No change. The urethral discharge has lessened and is whitish, but is still positive for gonococci. The intravenous mercurochrome discontinued for a few days because the patient is salivated.

March 26, 1929. Temperature, 99°–101°–102° F.; pulse, 100. Another course of the intravenous mercurochrome and glucose solution started.

April 5, 1929. X rays of teeth reported as follows: Nos. 2 and 3, roots infected and badly absorbed; Nos. 4 and 5, apical abscesses; Nos. 10, 11, 12, 13, 28, and 29, infected and partially absorbed and the bone rarefied; Nos. 17 and 32, impacted, infected; No. 20, unerupted and infected; Nos. 23, 24, 25, and 26, pyorrhea pockets; Nos. 30 and 31, mesial roots infected and partially absorbed and the bone rarefied.

April 15, 1929. Teeth Nos. 1, 2, 3, 4, and 5 all badly abscessed. These were extracted under local anesthesia and the bone curretted.

April 16, 1929. Temperature, 98.6°–102° F. The second course of the intravenous mercurochrome and glucose solution discontinued after five injections, because of marked salivation. The pain in the knee joint has diminished only slightly since the patient was admitted. Fluctuation is noted especially just above the patella. The knee joint was tapped and 50 c. c. of a thick, cloudy, straw-colored fluid withdrawn. No urethral discharge present; only an occasional morning tear. Protargol injections reduced to one a day. Urine: Negative, except for pus cells.

April 18, 1929. Culture of the fluid withdrawn from the knee joint reported positive for gonococci.

April 20, 1929. X-ray examination of the bones of the right knee joint fails to reveal any bony changes in this joint. An extensive exudate within the capsule is present, however, evidenced by widening of joint spaces.

April 20, 1929. Temperature, 99°–103° F.; pulse, 100. The knee joint was tapped and 10 c. c. of a thick bloody, purulent exudate withdrawn and 17 c. c. of a 1 per cent solution of mercurochrome injected into the joint cavity.

April 21, 1929. Temperature, 99.2°–100° F.; pulse, 88. The pain in the joint is slight and the patient is resting much easier.

April 23, 1929. Temperature, 99°–101° F. The knee joint was again tapped and 60 c. c. of a thin, reddish, exudate was withdrawn, and 20 c. c. of 1 per cent mercurochrome injected.

April 25, 1929. Temperature, 99°–100° F. Only slight pain in the joint.

May 2, 1929. Temperature, 99°–100° F. An autogenous vaccine has been prepared from the fluid withdrawn from the knee joint. Injections of the vaccine were started to-day and will be given in increasing doses every fourth day. Blood culture on April 20, 1929, reported as negative. Urine: Clear. Prostatic smear: Negative.

May 14, 1929. Temperature, 98.6°–99° F., and occasionally to 100° F. Up part time in a wheel chair.

June 1, 1929. Temperature, 98.6°–99.2° F. The vaccine was discontinued on the sixth dose of 3 c. c. The patient stated that a few minutes after each injection of the vaccine a dull aching pain would start up in the joint and continue for several hours. The function of the joint is improving each day and the swelling is gradually subsiding.

June 12, 1929. Temperature occasionally rises to 99° or 99.2° F. There is no complaint of pain in the knee joint and the swelling has nearly disap-

peared. The function of the joint is nearly normal and all movements are performed without pain. X-ray examination of the right knee joint this date still fails to disclose any extensive bone changes. It is worthy of mention, however, that a small exostosis is extending from the medial surface of the tibia. The patient passed from observation at this time because of his transfer to the United States.

#### COMMENT

1. It is unusual to have a metastatic infection so early in the course of gonococcus infection of the urethra, especially when the infection is located entirely in the anterior urethra.

2. Withdrawing the infected synovial fluid and injecting a 1 per cent solution of mercurochrome into the joint cavity apparently brought the infection under control when other measures failed. It will be noted that each time following the above procedure there was a definite lowering of the temperature and a marked lessening of pain in the joint.

3. The use of the autogenous vaccine was also undoubtedly an aid in controlling the infection.

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#### MALIGNANCIES OF THE ANTRUM<sup>1</sup>

By G. B. TRIBBLE, M. D., F. A. C. S., Former Commander, Medical Corps, United States Navy

In a period extending over 13 years and embracing duty at the Naval Dispensary and Hospital, Washington, D. C., during the active days of the war, when thousands of cases were seen, only six malignancies of the antrum were recognized and all have resulted in fatalities. With the exception of diathermy, the various surgical means at present used, and X ray and radium were employed. To bring before the surgical section the subject of treatment by diathermy, either alone or combined with radium or X ray, is the purpose of this case report.

There is a striking similarity in the onset of antral malignancies from the clinical side, whether they be sarcoma or carcinoma.

*Onset.*—If originating from the ethmoid area or around the orbital plate, the first symptoms are often ocular. The nasal discharge is frequently more or less unnoticed, especially if there has been previous sinus disease. If originating in the floor of the antrum, or in rests, tooth sockets, or mucous glands, the first symptoms are dental, such as intractable dental neuralgias, which drive the patients from dentist to dentist and from extraction or currettage to more extractions or more currettage.

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<sup>1</sup> Read before the surgical section, Medical Society of the District of Columbia, Dec. 13, 1920.

Swelling around the eye or puffiness around the cheek is a relatively early symptom and is more persistent than with the inflammatory types of sinusitis.

There may be a thickening around the upper margin of the alveolus or a projecting mass in the hard palate or from the gum in the case of epulis. Later, the tissue may be swollen beyond recognition. Glandular involvement is not usually an early development and hemorrhage frequently occurs in late cases. If originating in an already diseased sinus the newer symptoms intensify the existing ones.

*Diagnosis.*—From the above symptoms, aided by X ray and the use of Röntgen opaque solution, it is easy to make a tentative diagnosis, and the final diagnosis can only be made by biopsy. The grading of carcinoma, as brought out by Broders, has been given much importance by the Mayo Clinic, but apparently in Cook County Hospital this has not been considered. It was formerly thought that polypi underwent malignant degeneration, but it seems more probable that it is simply a malignancy developing in a diseased sinus with polypoid degeneration.

#### CASE I

In 1918 a chief petty officer applied to the navy yard dispensary, dental section, for severe toothache from an apparently abscessed tooth. It was extracted, but no relief was obtained. The two adjacent teeth were extracted and the bone curetted, but still no relief. Patient was referred to the naval hospital. face swollen on the left side and a suppurating area in left upper molar region, with a projecting mass about the size of a small cherry resembling granulation tissue but more compact. Section for biopsy was made and was reported epulis. Radiograph showed opacity of the left antrum and post-nasal examination showed fungoid masses in the left nasopharynx. He had radium treatment at Baltimore and the large masses sloughed away, nasal antral wall separated on the left, and a smooth cavity from nares through to outer antral wall could be seen. The mass came away from the gum and left a clean epithelialized scar and it was an apparent cure. In about three months he began to feel weaker and almost at once, similar to syphilids, almost 200 sarcomata appeared in the skin and subcutaneous tissue and death followed in about six weeks.

#### CASE II

A minor clerk from the British Embassy who had badly diseased teeth and a septic mouth applied to a local dentist for treatment for continuous dental neuralgia, right upper jaw. In spite of extractions, pain persisted. Referred for examination of antrum, and at that time presented polypoid degeneration of the right middle turbinate, stuffy nose, and an offensive discharge. No glandular enlargement. Exploratory opening was made, and a section taken from a mass on the floor of the antrum which had a feel like deer horn in the velvet.

The section was reported to be carcinoma. Radium was put in and X ray given later. A temporary improvement seemed to occur, but a recession, with

a very offensive discharge, occurred, and death took place from a sudden hemorrhage, probably from the growth extending into the internal maxillary artery.

#### CASE III

Mrs. Y. Originally had applied for eye treatment, for a swelling in the neighborhood of the right tear sac. No improvement had resulted from local treatment, and it was recognized that there must be an underlying condition in the antrum, and on her being referred a nasal examination was made. Right nares was filled with polypoid tissue and a copious nasal discharge was noted. Puncture and aspiration of the right antrum showed free pus in it, but from other symptoms the tentative diagnosis of malignancy was made. The antrum was opened for exploration and tissue removed for section. It was found filled with rather dense tissue for granulations or polyps, more firmly attached in the upper nasal side. Biopsy report: Carcinoma. A temporary improvement occurred after the opening and drainage and the use of massive doses of X ray. Death occurred from exhaustion. The metastases, if any, were internal, probably gastrointestinal, for persistent nausea was a later symptom. This growth probably was of ethmoidal-antral origin.

These three cases are fairly typical of the usual malignancies and can not well be mistaken for plain suppurative sinusitis or an osteomyelitis, whether infectious or luetic.

In the exhaustive report by Gordon B. New (Malignant Tumors of the Antrum of Highmore. Arch. Otolaryngol., Chicago, 1926, IV, 201-214) he traces the development of methods of treatment at the Mayo Clinic. First, operation, still followed in Great Britain, but superseded at the Mayo Clinic by low-heat destruction with a soldering iron.

Results improved, especially by selecting the cases according to degree of malignancy. The reported cases, after several years of apparent recovery from that clinic, were those so treated. His last cases were treated by diathermy which, in turn, supplanted the cautery, and as an auxiliary agent X ray or radium was used. New believes with low-grade tumors, including the mixed, one must depend on the cautery or diathermy, while in the high-grade epitheliomas and sarcomas radium is indicated rather than the cautery. Diathermy without X ray or radium was the method employed at Cook County Hospital.

*Technique.*—That used in Cook County and shown at the recent Clinical Congress of the College of Surgeons was as follows: Sodium amital or rectal oil ether anesthesia was used. The use of avertin had been given up in this clinic and oil ether as a rectally administered anesthetic again had been employed.

The diathermy point was about the size of a slightly flattened ice-pick point and was plunged around the growth in a series of punctures, then plunged repeatedly into the growth, and the coagulated tissue scraped out with a large curret. When bleeding was encountered the spitting charring spark was used. Entire surgical

destruction from the orbit to the lip and from the septum to cheek was several times seen.

The technique was the same for carcinoma of the external ear when the whole auricle, superficial layers of bone over the mastoid and temporal areas were removed. In the cases involving the tongue, the lower jaw, or floor of the mouth the same general procedure was followed.

Secondary bleeding was relatively rare and was controlled by packing. In some cases a preliminary gland dissection had been done. As before stated, no attention was paid to the grouping of carcinoma, and if a recurrence, or any peculiarity about the granulation was noted, diathermy was again done. It was their belief that recurrences come quickly, in a few weeks, if incomplete destruction had resulted. At this clinic all the failures from private hospitals were seen to foregather and no faith was put in radium in any form or in X ray. In fact, many of these cases had been previously treated by X-ray or radium.

Plastic operations and various appliances were used to cover the defects and no hesitancy because of extent of the growth was noted. The results were good, several cases being shown after three and four years' freedom from treatment.

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#### A USEFUL METHOD OF SKIN DEFECT CLOSURE

By J. W. KIMBROUGH, Lieutenant (Junior Grade), Medical Corps, United States Navy

In closing a skin defect due to wounds, excision of moles, scars, tattoo marks, etc., more or less difficulty is frequently encountered. This is often the case where the defect is too large to be closed simply by the sliding graft method, and yet is not large enough to warrant any extensive transplantation procedure. Such closures are desirable, if for no other reason than the satisfaction of having done a neat job. In addition, however, there are the indications resulting from the consideration of appearance or the function of some part. The following method of closure has been found very successful in such cases:

Bleeding is arrested without ligatures, if possible. The skin edges are undercut (shown by dotted lines) as for a sliding graft. In doing this care is taken that the overlying skin is of sufficient thickness to insure its adequate blood supply. The extent to which the skin edges are dissected free is dependent upon the size of the defect.

Two incisions are made, one on each side of the defect and parallel with its edges, which are carried through the skin and down to the

undercut near its outer limit, resulting in the formation of two cutaneous bridges. The distance of the lateral incisions from the edges of the defect depends upon the extent of the latter.

A curved needle with a cutting edge, carrying a No. 0 or 00 silkworm gut suture, is introduced near the end of one of the lateral in-

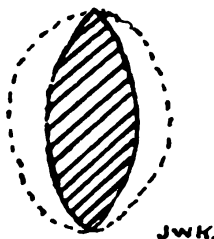


FIGURE 1

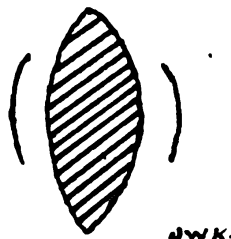


FIGURE 2

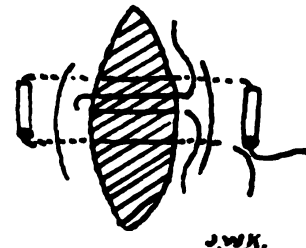


FIGURE 3

cisions and well back from its edge and carried into the subcutaneous space formed by the dissecting loose of the skin edges. From here it passes to the opposite incision to emerge in a similar manner. Next the suture passes through a short piece of small rubber tubing formed by cutting a section from a small catheter (usually about one-quarter inch cut from a No. 10 F catheter). The needle again enters the skin as at first and emerges on the side of origin. The end of the suture is carried through a second rubber tube similar to the first.



FIGURE 4

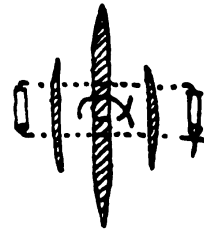


FIGURE 5

A single through-and-through suture of No. 4 silk passes through the middle of the cutaneous bridges.

The silk suture is tied in a surgeon's knot and the skin edges brought closer together, thus opening up the lateral incisions.

The silkworm gut suture is tied in a surgeon's knot and tightened until the lateral incisions are either entirely or partially closed. The two sutures, being tied in surgeon's knots, can be tightened alternately until perfect approximation is secured, or, if this is impossible, until the defect is equally distributed between the three small areas. Additional through-and-through sutures may be placed at either end of the original defect if desired.



As a result of the above procedure it is possible to secure three inconspicuous linear scars in place of a single large one, the healing of which is delayed and the end result of which may be disfiguring or crippling.

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**AN EFFECTIVE SUBSTITUTE FOR COLLODION**

By R. CUTHBERTSON, Commander, Medical Corps, United States Navy

While attending the clinics at the University of Vienna recently, I noted the use of mastisol in the clinic of Dr. Lorenz Böhrer, who is chief surgeon and director of the Vienna Accident Hospital.

The formula of mastisol is: Resin, 20 grams; chloroform, 50 c. c.; linseed oil, 20 drops.

The above is cheap, easily prepared, and an effective substitute for collodion. In fact, it is easier to apply, more flexible, more elastic, and easier to remove than collodion.

A trial of this preparation is suggested. It will be found to be more satisfactory than collodion in every respect.



## RESERVE CORPS

### NEW APPOINTMENTS IN THE NAVAL RESERVE SINCE OCTOBER 1, 1929

	Rank	Class	Appointed
Arnold, Herman Bruno.....	Lieutenant (junior grade)...	MC-V(G)....	Nov. 25, 1929
Barnard, Hamilton I.....	Lieutenant.....	MC-V(S)....	July 17, 1929
Cason, William M.....	Lieutenant (junior grade)...	MC-V(G)....	Oct. 18, 1929
Cowlbeck, Harry D.....	do.....	MC-V(G)....	Oct. 21, 1929
Foote, Frederick Sanford.....	Lieutenant.....	MC-V(S)....	Sept. 28, 1929
Hockett, Verden E.....	Lieutenant (junior grade)...	MC-V(G)....	Oct. 24, 1929
Livingston, Stanton Knowlton.....	do.....	MC-V(G)....	Oct. 16, 1929
Losli, Ernest Jacob.....	do.....	MC-V(G)....	Oct. 1, 1929
Monat, Henry Anatol.....	do.....	MC-V(G)....	Sept. 7, 1929
Vanderkamp, Harry.....	do.....	MC-V(G)....	Aug. 5, 1929
Wetherell, Bryant David.....	Lieutenant commander.....	MC-V(S)....	Nov. 2, 1929

	From—	To—
<b>PROMOTIONS</b>		
Bailey, Frederick James.....	Lieutenant, MC-F.....	Lieutenant commander, MC-F.
Clemmer, Leon.....	Lieutenant, MC-V(G).....	Lieutenant commander, MC-V(G)
Collier, Dana Monroe.....	Lieutenant, MC-F.....	Lieutenant commander, MC-F.
Cowles, William Lee.....	do.....	Do.
Flanders, Walter Hubert.....	do.....	Do.
Healy, Thomas Raymond.....	do.....	Do.
McCurdy, Russell James.....	Lieutenant, MC-V(G).....	Lieutenant commander, MC-V(G)
Miller, Hugh McCauley.....	Lieutenant, MC-F.....	Lieutenant commander, MC-F.
Mullen, Edward Andrew.....	do.....	Do.
<b>TRANSFER</b>		
Herndon, Raymond F.....	Lieutenant commander, MC-V(G).	Lieutenant commander, MC-F.



# NURSE CORPS

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## A SUMMER SESSION AT COLUMBIA UNIVERSITY

By JOANNA FERRIS, Nurse, United States Navy

It was my privilege this past year to attend the six weeks' summer session at Teachers College, Columbia University, New York, under orders from the Bureau of Medicine and Surgery. Our course included the study of modern methods in teaching and the psychology underlying these methods. The subjects were taught from the viewpoint of nursing education and were given under the three headings: Educational Psychology for Nurses; Teaching of Nursing Practice; Teaching in Nursing Schools.

In the following pages the subjects listed above will be taken in order. The reader's interest in the paper will be measured by my ability to present the subjects in an attractive manner and one's like or dislike of the subjects, as they pertain strictly to nursing education.

### EDUCATIONAL PSYCHOLOGY FOR NURSES

The question is often asked, "Why should a nurse study psychology?" There are several reasons, which may be stated as follows:

(a) To understand people. Certainly a nurse, to be successful, should know how to deal with people, and this knowledge can be obtained only by first understanding them.

(b) Because a nurse is or should be a student. Nurses should be increasing their store of knowledge constantly, for unless we advance we go back. There is no standing still. A study of psychology teaches us good study methods.

(c) As a preliminary to psychiatric nursing. The need of having an understanding of mental cases is constantly increasing, and especially so for nurses. If she does not understand the normal reaction expected of a normal person, no nurse will be able to understand the abnormal or exaggerated reaction of the person suffering from a mental disturbance of any degree.

(d) To make more effectual the therapeutic measures used in treating a patient. It is common knowledge to-day that mental ease

is a great factor to be considered in the treatment of any kind of disturbance.

(e) To help the nurse to make better adjustments. Anyone who understands people and is able to "get along" with them is certainly better equipped to adjust herself to any circumstances. This is particularly valuable to the Navy nurse, who of necessity meets with constantly changing conditions.

(f) To aid her in "getting along" with nervous, difficult patients.

(g) To aid her in dealing with family and friends of patients.

(h) As a general aid in "getting along" with people. The last three reasons might be considered as subdivisions of the first.

In addition to the reasons listed above, there are other advantages from the viewpoint of education, which a nurse obtains from a study of psychology. She has an excellent opportunity to refresh her knowledge of the nervous system, or, as it is known in psychology, the receiving, the connecting, and the reacting mechanisms. A realization is brought home to her of the necessity of an excellent background of general anatomy and physiology.

In beginning a course in general psychology we are concerned first with the question of what is included in a study of psychology. The answer to this question is that psychology is a scientific study of behavior. In this study of behavior we include all reactions and absence of reactions. These reactions include speech, emotion, glandular stimuli, and mental activities. Behavior may be studied by two methods, the one following the tenets of the behavioristic school and the other the tenets of the introspectionists. To-day most of our noted psychologists stand between these two schools.

General psychology may be outlined in this manner:

1. Experimental research:

(a) Animal or human subjects.

2. Specialized psychology:

(a) Genetic—infancy, childhood, adolescence, and senescence.

(b) Education—spelling, music, art, and arithmetic.

(c) Social—group and individual management.

(d) Professional—teachers and nurses.

(e) Business—advertising and salesmanship.

(f) Abnormal—delinquent children, criminal adults, psychiatry, various neuroses, Freudism, and temporary conditions of normals.

In order that these branches may be studied scientifically, certain definite rules must be laid down as in any scientific study. First, we must have a trained observer; second, a control of variables; third, isolation of the facts to be observed; fourth, arrangement for repetition; fifth, employment of objective methods; sixth, a state-

ment of results in quantitative terms; seventh, statistical results must be obtained.

Certain general laws have been adopted, the most important of which are:

1. The law of parsimony or Lloyd Morgan's canon.
2. The reaction hypothesis or the law of cause and effect.

The law of parsimony is that explanation of a situation which is the lowest in the psychological scale: "Of two rival hypotheses, that one shall be chosen which is the simplest and explains the most." The reaction hypothesis tells us that all forms of behavior are reactions or responses to specific stimuli. Fully understanding this law, we may formulate several generalizations concerning the predictability of responses.

1. We may consider certain responses as absolutely predictable in all races.
2. We may consider certain responses as fairly predictable if we know the type of group with which we are dealing.
3. Certain responses may be predicted in normal healthy beings.
4. Education will greatly affect the predictability of a response.
5. We know that some responses can not be predicted because of the many different experiences that different groups may have had.

Responses predictable in all mankind in health or disease:

- (a) Sudden loss of support—fear.

Responses predictable in all normal persons in health:

- (a) Sudden flash of light—contraction of the pupil of the eye.

Responses fairly predictable in large groups because of experience:

- (a) Sudden cry of "Fire" in theater—panic.

Responses predictable in small groups because of education:

- (a) Oil of chenopodium—hookworm.

Responses which prove practically unpredictable:

- (a) Cast—India, drama, fishing, urinalysis, plaster, bowling, and archery.

In order that a response be made, we must have a specific stimulus or complex stimuli, which in psychology is called the "total situation." For example, have you ever noticed the different responses offered under these differing conditions: When a patient's dressing is done in the presence of a sympathizing friend or relative? When it is done in the morning or late afternoon? The total situation is the composite of numerous stimuli. The response is the reaction which is made by these stimuli.

The human behavior mechanism is extremely complex, but its functional unit, called the stimulus response bond or the S-R bond, is relatively simple. This S-R bond includes the receiving, the connecting, and the reacting mechanisms. "The sum total of an indi-

vidual's S-R bonds at any given moment determines just what response he will make to a given situation." The nature and number of the sense organs are determined by their biological usefulness. They serve to adjust the mechanism to that environment which favors survival.

Every nurse knows the structure of the sense organs, so in a study of psychology for nurses this subject need not be discussed. However, the rôle of the S-R bond will be new to many. General psychology is concerned with faulty behavior due to faulty sense organs and peculiar behavior due to faulty use of sound sense organs. Both aspects are significant in the application of psychology to nursing problems.

The functioning of the sense organs is often influenced by illness, either to increase or decrease their sensitivity, with corresponding changes in behavior. The nurse trained in psychology will recognize and seek to eliminate the types of stimuli which are universally annoying during illness. In addition she will know that through each type of sense organ she may hope to secure responses which will hasten recovery. Every nurse requires all of her sense organs to be unimpaired, and years of training and experience should serve to establish bonds between these and the response which should prove most useful in a nursing situation. The receiving mechanism includes visual, auditory, olfactory, gustatory, skin, and organic sense organs.

The connecting mechanism is the great central adjuster. Here we find three levels of response, beginning with the lowest or first level responses and going to the highest or third level, cortical responses.

The response mechanisms include the muscles, glands, and the cortical neurones. The entire nervous system may be likened to a great telephone system. The strategic points in a telephone system are where the operator plugs in. In the nervous system, in a like manner, we have points of potential connection where functional contact may be established, known as synapses. When a given receptor has been connected with a given effector a sufficient number of times, we have a path of least resistance established, called an S-R bond, which is more or less permanent. Since a nerve impulse follows the line of least resistance and the degree of resistance offered to a nerve impulse is called the "threshold," it naturally follows that lowering this threshold in one series of synapses and raising it in another determines the response which will be made. Again, since all learning necessitates the overcoming of resistance of new synapses—the establishment of new S-R bonds—there is no "royal road to learning." We have learned, however, that some



methods of overcoming this resistance are better than others, so psychologists have formulated certain important "laws of learning."

We know that when a response organ is stimulated it performs its function. The function of a muscle is motion; of a gland, secretion; and of certain cortical neurones, mental activity. Just as muscles and glands do not react unless stimulated, so we find that sensation, imagination, and recollection appear only when these cortical neurones are stimulated.

#### NATIVE TRAITS AND TENDENCIES

Each and every "native trait" is already determined in the chromosomes of the fertilized cell destined to become a new individual. Most native traits are modifiable; some are transitory and some delayed. The last named is due to incomplete development of the behavior mechanism. The native tendency to dominate and the native tendency of gregariousness are of special interest to the nurse. It is an easy matter, when the first-mentioned tendency is overindulged, to become too autocratic with patients. The second, if we give it sufficient thought, will make us realize the necessity of making the patient, especially in a large ward, feel at home. There is no loneliness so poignant as that felt in a crowd. To return to the native tendency to dominate, the nurse must never forget that patients, too, have this tendency, and if it is thwarted we have sulking and stubbornness among our patients and in turn a most unhappy, ill-tempered ward.

Native intelligence varies greatly in individuals, and equality of opportunity increases rather than decreases these differences. For this reason it is well not to expect too much of anyone unless we know very definitely the mental capacity of the individual. Thwarting of native traits and tendencies often sets up many maladjustments. Sufficient knowledge of psychology will aid the nurse in helping to correct such maladjustments and will possibly result in changing the entire course of an individual's life. When thwarting does take place, satisfaction is obtained through numerous channels. Some of these are:

- (a) Rationalization or self-justification.
- (b) Day-dreaming (suffering or conquering-hero type).
- (c) Pollyanna (the whatever is, is best, attitude).
- (d) Capitalization (exaggeration of weakness and virtues). This type of adjustment may be observed any time in the sun room or porch where convalescent patients congregate.

#### INDIVIDUAL DIFFERENCES

No two individuals react in exactly the same way to the same situation. The nurse with a knowledge of the innate tendencies of

the human race should be able to predict with a fair amount of accuracy what a patient's reaction will be or why he reacts as he does. In addition, knowing how greatly people differ, every nurse will have an added interest in her patient as an individual, not as a "case." She will attempt to nurse the mind as well as the body.

#### TESTS AND MEASUREMENTS

General intelligence is largely inherited. It shows a growth curve similar to the curve of physical development. The distribution of intelligence in any large unselected group is believed to be according to the theoretical probability curve.

#### PSYCHOLOGY OF LEARNING

All learning is by reacting. Native tendencies, native plasticity of the nervous system, and native states of readiness are basic in the formation of new bonds. Laws of learning which tend to fix reactions are:

1. *The law of readiness.*—"Readiness provides that a response shall be made to some element to which previous reactions have been made or for which there are native connections."

2. *The law of exercise.*—"When a given stimulus has been connected with a specific response a sufficient number of times, it tends to arouse that response in preference to any other potential response."

3. *The law of effect.*—"That reaction tends to be repeated which is accompanied by, or is immediately followed by, a satisfying state of affairs."

Teaching is the art and science of creating situations which will arouse the desired response. Therefore, the teacher to be successful must be familiar with the laws of learning, even though she may not know them by name.

#### ECONOMICAL LEARNING—HOW TO STUDY

1. Keep your body in the best possible physical condition.
2. Arrange for the impression of new material through all possible sense organs.
3. Minimize distracting stimuli, internal and external.
4. Assume from the first an attitude of close attention directed toward a definite goal or end. Respond with the intent to learn and remember.
5. Take a problem-solving attitude.
6. Take a preliminary survey of new material before studying in detail.
7. Attack your hardest problems when you are freshest.
8. Summarize frequently in your own words.

9. Use new ideas as soon as possible.

10. Overlearn sufficiently for the inevitable loss through forgetting.

11. Practice recall in the way material will be used in life situations.

12. Space your learning periods. Thirty minutes or less a day devoted to the study of a subject is more economical than several hours devoted to it once a week.

13. Utilize the laws of vividness and effect whenever possible. Seek to discover new ways to make impressions vivid.

14. Try to increase your reading time. Rapid reading usually means greater concentration.

#### TEACHING OF NURSING PRACTICE

What is meant by the word "principle" when applied to nursing practice? According to the dictionary, a principle is "a source or cause from which a thing proceeds." Naturally the question arises, Do we teach our student nurses the source or cause from which a thing proceeds? It is the opinion of leaders in the nursing profession that, in the past at least, sufficient attention has not been directed toward this phase of teaching. In order to obtain desirable results from our teaching in our student classes, we have learned that knowing how is not sufficient, the student in addition to knowing how must know why. This can only be brought about by teaching underlying principles. In other words, the student must be given a background made up of knowledge of at least some of the basic sciences and the practical arts. With this foundation she will carry on her nursing procedures with knowledge as well as motor skill. Motor skill without intellectual skill or knowledge, while it suffices possibly for ordinary tasks, is not sufficient for any of the many specialized duties the nurse of to-day is called upon to perform. To illustrate: In the simple everyday task of taking temperatures we find, if we stop to think, that the person who takes a temperature, as we say, intelligently has at her command quite a fund of knowledge. First, she must have some knowledge of physics, for if she does not she can not appreciate the delicacy of the instrument she is handling and will not use proper care in "shaking down" the thermometer, the probable result being the breaking of the delicate mechanism. Second, she must have knowledge of anatomy; otherwise, how will she know where the big blood vessels may be and which is the best closed cavity to use for the purpose of obtaining an accurate temperature? Third, she must possess a knowledge of physiology, in order to appreciate the significance of the reading she obtains. Fourth, it is necessary for her to have knowledge of bacteriology, in order that she may

know what disinfectant solution will be most efficacious for destroying any bacteria which may be on the thermometer after use. Finally, it is essential that the nurse have a knowledge of personal hygiene, in order that she may appreciate the necessity of washing her hands before and after taking temperatures. This, it would seem, makes quite a list of "underlying principles" in the simple procedure of taking a temperature. With this knowledge no nurse will ever neglect any one of the steps which are essential to the taking of an accurate temperature and for the safety of her patients and herself.

#### SCIENTIFIC MANAGEMENT AND THE STANDARDIZATION OF HOSPITALS

What is scientific management and what are its advantages and disadvantages as applied to hospitals and hospital schools? Frederick Taylor, a mechanical engineer, is called the father of scientific management. He believed that this type of handling an industry would bring about the following results: (a) Low cost with maximum output; (b) equitable distribution of product; (c) high wages; (d) industrial peace; (e) reduction of unemployment. The elements of scientific management are: (1) Planning department for each department; (a) time studies of every task; (b) instruction cards; (c) divided foremanship; (2) standardization of tools and equipment; (3) motion study; (4) standardization. How far shall we standardize hospitals? To be sure, there are certain advantages which may be listed, as follows: Standardization (1) makes for uniformity; (2) makes for improvement in technic; (3) it saves time, money, and material; (4) it simplifies where there are many medical officers; (5) it gives the nurse more confidence. Disadvantages necessarily appear, namely: (1) The patient feels like a case; (2) the patient is bored and unhappy; (3) treatments are interfered with because of the patient's mental state. As for the nurse, it makes her unadaptable, mechanical, specialized in method, and unresponsive.

It is difficult to know just how profitable it would be to adopt scientific management and bring about standardization of our hospitals. Generally speaking, it would seem to be an excellent idea. But in the teaching of nurses do we want to develop human machines or do we want to develop nurses who possess not skill alone but adaptability, sympathy, and knowledge? Standardization to a certain point would doubtless be very much worth while, but care is needed in order that we may not defeat our main objective, namely, the training of thinking, intelligent nurses.

In teaching nursing courses certain objectives are always in view, and these are:

- (1) To teach underlying principles of nursing practice.
- (2) To develop technical skill.

- (3) To stimulate thinking.
- (4) To acquaint with resources in order that the nurse may make independent judgments.
- (5) To develop powers of appreciation.
- (6) To develop powers of observation.
- (7) To make nurses conscious of right attitudes and values.
- (8) To teach nurses to become good managers.

The first objective has been discussed. The second may be obtained by perfect demonstration, initiative on the part of the student, early practice, spaced practice, frequent practice, and finally by overlearning. The third may be obtained by using various teaching methods to set up a problem-solving attitude. The fourth will follow the intelligent use of reference material. The fifth, sixth, and seventh will depend upon the teacher's personality, the development of esprit de corps, and the teaching methods used. The last will depend upon the ability the student has developed to make self-criticism and to analyze her problems.

In teaching nursing practice, there are four important steps to be followed to obtain the desired results:

- (1) Lecture and demonstration by the teacher.
- (2) First demonstration back by the student.
- (3) Practice in class under supervision.
- (4) Practice in the ward under supervision.

If these four steps can be followed by a teacher possessing the necessary qualifications, good results should be obtained in the teaching of nursing practice.

In order that the teacher may be sure that she will teach underlying principles, provide for the development of independent judgment, provide for certain concomitant learnings, that she will correlate her subjects with other subjects taught and will teach a really good lesson, she must do two things. First, she must have some sort of general plan of her entire course; second, she must have a very definite knowledge of the subject matter to be covered in each separate lesson. The teacher may obtain these results by making a course outline and lesson plans.

The course outline should provide a calendar for the year, showing the number of hours allowed for the course and the main items of content. It blocks out for the teacher the units of subject matter. Lesson plans should be made daily to make for continuity in getting over the subject matter. A lesson plan is a definite, organized, written plan which contains an account of the subject matter and a description of the method. The purposes of the plan are: (1) An agency for training a teacher; (2) for the inexperienced teacher it acts as a crutch; for the experienced teacher it makes for improve-

ment; (3) it helps the poor teacher to analyze her difficulties and to learn where the fault lies in her teaching.

A model lesson plan is submitted.

#### SUGGESTIONS FOR A LESSON PLAN

- I. Subject: Nursing Practice:
  - A. Topic: The Three Cardinal Symptoms.
- II. Class: Preliminary students, fourth month (four months' preliminary period).
- III. Aims:
  - A. To help the students understand the significance of temperature in health and disease.
  - B. To teach the students the technic of taking temperature skilfully.
  - C. To give the students an appreciation of the importance of observing and recording these symptoms.
- IV. Brief outline of lesson:
  - A. General facts about body heat.
  - B. Specific facts about body heat.
  - C. The clinical thermometer.
  - D. How to take temperature—
    1. By mouth.
    2. By rectum.
    3. By axilla.
    4. By vagina.
  - E. Importance and technic of recording temperature accurately.
  - F. Summary.
  - G. Assignment.
- V. Illustrative material:
  - A. Diagram of thermometer on board, large enough to see  $\frac{1}{5}$  signs.
  - B. Enlarged clinical chart drawn on blackboard or made into a larger chart.
  - C. Temperature book like one in wards.
  - D. Charts: Bedside and clinical, showing lysis, crisis, intermittent and remittent fevers. One blank clinical chart for each student.
  - E. Mimeographed sheets of directions for taking temperature, for students.
  - F. Chase doll.
  - G. Towel.
  - H. Special equipment. (Equipment suggested by Force and Kerr, reference No. 4. It should be enumerated here, according to technic to be adopted.)
- VI. References for the teacher:
  - A. Text Book of Anatomy and Physiology for Nurses, Kimber-Gray. Body Heat, pp. 511-519 (7th ed.).
  - B. Principles and Practice of Nursing, Harmer.
  - C. Modern Hospital, April, 1925. Clinical Thermometer Bill Passes Senate.
  - D. Modern Hospital, August, 1920. The Efficient Disinfectant of Hospital Clinical Thermometers.
  - E. Modern Hospital, 1916, The Clinical Thermometer as a carrier of Infection—Mortocci—Pisculli, L.
  - F. Nurs. Ed. Bulletin, No. 1, Vol. II—Winter No. 1929—Studies in Thermometer Technique—Erdmann and Welsh.

## VII. Connection with the last lesson :

## A. Last lesson on symptoms in general—

1. What is a symptom?
2. Compare the two classes of symptoms, illustrating each kind.
3. Why should temperature be called one of the *cardinal* symptoms?

SUBJECT MATTER (CONTENT)	METHOD (How)
<p>VIII. Subject matter outlined in detail:</p> <p>A. Review of general facts in relation to body temperature—</p> <ol style="list-style-type: none"> <li>1. Meaning of body temperature.</li> <li>2. Production of heat.</li> <li>3. Distribution of heat.</li> <li>4. Loss of heat.</li> <li>5. Balance between production and loss.</li> <li>6. Heat regulation and control.</li> </ol> <p>B. Specific facts about body temperature in relation to taking temperature—</p> <ol style="list-style-type: none"> <li>1. Temperature blood; temperature of cavities—           <ol style="list-style-type: none"> <li>a. Open.</li> <li>b. Closed.</li> </ol> </li> <li>2. Places to take: Mouth, rectum, axilla, vagina.</li> <li>3. Variations of normal temperature due to: Time of day, age, physical conditions of individual.</li> <li>4. Deviations from the normal temperature—           <ol style="list-style-type: none"> <li>a. Fever—               <ol style="list-style-type: none"> <li>(1) Meaning.</li> <li>(2) Kinds, according to degree, hyperpyrexia, high, etc.</li> <li>(3) Causes, infections, sunstroke, nervous disorders, pain.</li> <li>(4) Course of fever, onset, gradual or sudden; subsides, lysis, crisis.</li> <li>(5) Importance of knowing what the temperature of the patient is.</li> </ol> </li> </ol> </li> </ol>	<p>How is heat generated in the body?</p> <p>Explain the difference between the regulation of heat of a warm-blooded and a cold-blooded animal.</p> <p>Compare the old with the new conception of fever. Contrast the three types of fevers. Name a condition in which each may be present.</p>

SUBJECT MATTER (CONTENT)	METHOD (HOW)
<p>VIII. Subject matter outlined in detail—Contd.</p> <p>C. The clinical thermometer—</p> <ol style="list-style-type: none"> <li>1. History of the development of thermometer from 1592–1929. “At first the art of temperature taking was confined to the physician, but eventually, as the procedure became more general and proved too time absorbing, the task was delegated to nurses, but not without protest from many old-time nurses as well as doctors.” Goodnow, Hist. Nursing.</li> <li>2. Principles underlying the mechanism of the thermometer— <ol style="list-style-type: none"> <li>a. Choice of glass.</li> <li>b. Mercury as a recording column— <ol style="list-style-type: none"> <li>(1) Liquid.</li> <li>(2) Expands uniformly.</li> <li>(3) O p a q u e , therefore quite visible.</li> <li>(4) D o e s not stick to glass stem.</li> <li>(5) Large power of expansion.</li> </ol> </li> </ol> </li> <li>3. The two scales, and rules for transposing— <ol style="list-style-type: none"> <li>a. Centigrade–Fahrenheit: Multiply by <math>\frac{9}{5}</math> and add 32.</li> <li>b. Fahrenheit–centigrade: Subtract 32 and multiply by <math>\frac{5}{9}</math>.</li> </ol> </li> <li>4. Legislation in regard to the sale of thermometers.</li> <li>5. How to read.</li> <li>6. How to shake down.</li> <li>7. How to test in hospital.</li> <li>8. Provision for distinguishing between mouth and rectal thermometers.</li> <li>9. Clinical thermometers as carriers of infection.</li> </ol>	<p>Teacher gives review problem for students to work out at their seats.</p> <p>Transpose 93° C. to the Fahrenheit scale.</p> <p>Transpose 97° Fahrenheit to the centigrade scale. If all students do not get right answers, teacher works it out on the blackboard.</p> <p>Referring to large diagram on board, teacher explains.</p> <p>Teacher demonstrates and then gives one to each student to shake down and read.</p> <p>Teacher illustrates a true incident of a calamity due to thermometers registering incorrectly.</p> <p>Teacher compares a rectal and mouth thermometer to emphasize the differences.</p>



SUBJECT MATTER (CONTENT)	METHOD (How)
<p>VIII. Subject matter outlined in detail—Contd.</p> <p>C. The clinical thermometer—Contd.</p> <p>10. Care—</p> <p>a. Cost.</p> <p>b. Regulation in regard to breakage. (Constriction above bulb vulnerable spot.)</p> <p>c. Individual care of thermometers.</p> <p>d. Daily care of tray.</p> <p>D. How to take temperature—</p> <p>1. By mouth—</p> <p>a. Normal mouth temperature.</p> <p>b. When not to take temperature by mouth.</p> <p>c. Procedure—</p> <p>(1) Nurse washes her hands.</p> <p>(2) Explanation to patient, purpose and technique.</p> <p>(3) How to insert thermometer.</p> <p>(4) Length of time to register.</p> <p>(5) Supervision of patient during procedure.</p> <p>2. By rectum—</p> <p>a. Normal rectal temperature.</p> <p>b. Advantages of using this method.</p> <p>c. Procedure.</p> <p>d. After care of rectal thermometers.</p> <p>3. By axilla—</p> <p>a. Normal axillary temperature.</p> <p>b. When to use this method.</p> <p>c. Procedure.</p> <p>d. Care of thermometers.</p> <p>4. By vagina—</p> <p>a. Normal vaginal temperature.</p> <p>b. When to use this method.</p> <p>c. Procedure.</p> <p>d. Care of thermometers.</p>	<p>Under what circumstances should temperature not be taken orally?</p> <p>Teacher demonstrates on student called up before the class.</p> <p>Teacher demonstrates on the doll, as a helpless patient.</p> <p>Teacher demonstrates on the doll and on a student.</p> <p>Account for the differences in temperature found in these four places in the body.</p> <p>Which method would be most reliable?</p>

SUBJECT MATTER (CONTENT)	METHOD (HOW)
<p>VIII. Subject matter outlined in detail—Contd.</p> <p>D. How to take temperature—Contd.</p> <p>5. Recording temperature—</p> <p>a. Times of day when temperatures to be taken.</p> <p>b. Use of temperature book, bedside sheet, clinical sheet.</p> <p>c. Importance of accurate recording.</p> <p>E. Summary of lesson (chiefly on points in procedure).</p> <p>F. Assignment for next lesson—</p> <p>1. Harmer—Principles and Practice of Nursing, Chs. XIV and XV, "Pulse and Respiration."</p> <p>2. Submit clinical charts next time indicating one week's temperature of a ward patient with an abnormal temperature. Be able to state the diagnosis of patient's condition, and in a general way the cause and type of temperature.</p> <p>3. Prepare for a new type examination on the past two lessons, on symptoms and temperature.</p>	<p>Teacher shows temperature book and hands it around.</p> <p>Teacher gives bedside and clinical sheet to each student.</p> <p>Using large clinical chart on board, teacher draws dots and explains the method of making clinical sheet.</p> <p>Teacher requires each student to record some temperatures given by her at random in order that they may get practice in making dots the right size, etc.</p> <p>Teacher arranges for one-half hour of supervised practice for groups of 8 in classroom preparatory to taking the same group to the wards to practice.</p>

## TEACHING IN NURSING SCHOOLS

*Purpose of the course.*—1. To discuss certain *general problems* relating to teaching the various subjects of the nursing curriculum, such as (a) the physical factors conditioning good teaching; (b) the selection and use of teaching equipment and illustrative material; (c) the methods of teaching best adapted to the various nursing subjects; (d) the psychological laws and principles underlying each method; (e) methods of evaluating teaching; (f) selection of text and reference books; (g) class management; (h) correlation of classroom and ward teaching; (i) records which must be kept by the teacher.

2. To contrast and compare the aims and objectives of the nurse instructor when teaching (a) sciences; (b) professional subjects; (c) clinical subjects; (d) practical arts.

3. To afford limited practice in (a) evaluating the course outlines suggested by the standard curriculum; (b) adapting course outlines to a specific group; (c) making lesson plans in subjects taught in schools of nursing.

4. To afford limited opportunity for the observation and evaluation of teaching.

*Physical factors conditioning good teaching.*—1. The student body: (a) There should be a physical examination of the student upon admission to the school; (b) there should be a yearly examination, and health recommendations should be made and carried out; (c) living conditions should be good and should include single rooms, adequate bathing facilities, recreational facilities, laundry, library, detached quarters, rooms for entertaining guests, and, if possible, an adviser for mental problems. Vacations should be for a period of one month, if possible. Classes should be counted as working hours. Time off duty should be known by the student far enough ahead so that she may plan for anything she may wish to do; otherwise it loses the greater part of its value.

2. The teaching staff: There should be no relief work for the teacher and the teacher's time should be her own. Good living conditions and one month's vacation a year are also necessary.

3. Physical resources for good teaching include all teaching resources throughout the hospital—all clinical resources.

*The selection and use of teaching equipment and illustrative material.*—Teaching equipment should be the best available and should include sufficient classroom space, charts of all descriptions, one good model of a skeleton that may be disarticulated, specimens of all bones, organs preserved in alcohol, a stereopticon machine, blackboards, and sufficient number of windows. There should be a separate dietetic, chemistry, and bacteriology laboratory. All illustrative material should be readily available. To insure this, it would be well to keep a card index of all material, telling where each item is kept.

*The methods of teaching best adapted to the various nursing subjects.*—There are 10 methods which may be used in nursing schools: (a) Lecture; (b) recitation; (c) demonstration; (d) clinical teaching; (e) excursion; (f) laboratory; (g) case study; (h) discussion; (i) the Dalton plan; (j) the project plan. Of these the laboratory, the case study, the demonstration, the project method, and the excursion are the more valuable. Recitation has small place in nursing schools. The lecture and laboratory methods

are commonly used in all schools to-day. Some of the advantages and disadvantages of the different methods will be discussed.

The demonstration points out the goal and gives the student a perfect mental picture when properly conducted. The one weakness of this method is its lack of originality on the part of the student.

Clinical teaching is good, but has many disadvantages. It is slow, often interferes with ward work, and in small hospitals can not be used for lack of good clinical material. If this method is used, there must always be anticipatory preparation and check up afterwards.

In probationary classes the excursion method is good, but must be conducted with great care. The student must be "set" before going on an excursion, and a careful check up must be made afterwards to be sure the important features of the plant inspected have been noted.

The laboratory method gives the student intensive, clearer impressions; it develops skill, accuracy, and observation; gives some scientific training, and is especially good for lengthy, difficult problems.

Lectures are most useful for a quick review of a subject. If the lecture method is used the students should not be given mimeographed lectures or notes, but should be required to summarize the lecture and to hand in their notes for grading. This makes for student activity and requires thinking, both of which are essential to the training of efficient, intelligent nurses. Tray lists and diet lists may be given to the student for study and will act as time-savers.

Recitation method depends entirely upon the questions asked. It is good to test knowledge and to provide drill. It provides too much teacher activity, tends to faulty expression of ideas, and causes too much nervous tension on the part of the student.

Discussion classes provide for more student activity, stimulate interest, and encourage reflective thinking. The faults of these classes are many, namely: Too few students take part, there is an excellent opportunity to get away from the main topic, there is a lack of time for the teacher to amplify, and there is often a number of erroneous ideas expressed.

Case study is of great value as a teaching method. In this method a student studies a case from the time of admission to the time of discharge. This is particularly valuable in the teaching of advanced medical and surgical nursing procedures. The student sees the case as a whole, not as a separate series of units, as the sponge for temperature, the lumbar puncture, and so on.

The Dalton method and the project method are both very valuable, but can only be used by the specially trained instructor. The psychological laws underlying these different methods must be considered by the teacher. These were discussed at the beginning of this paper. The teacher must provide for interest or motivation on the part of the student, for immediate practice, for spaced practice, for supervision, and for overlearning. To do this, she will usually find that various teaching methods may be used in one class period with considerable success.

*Methods of evaluating teaching methods.*—1. Aims of the teacher: (a) Did the teacher seem to have a definite, clear-cut idea of what she wanted to accomplish? (b) What were the dominant aims? (c) Did the class know what the purpose of the lesson was? (d) Did they have any share in planning for it? Did they enter into it?

2. Subject matter: (a) Was the material reliable, up to date, scientific? (b) Was it well selected, considering the aims, the needs, and the interests of the group and the time available? (c) Was it well organized? Did the important things stand out? (d) Could anything have been profitably added to it to make it better?

3. Teaching method (evaluation): (a) Did the teacher make the most of the facilities at her disposal? (b) Was the type of exercise selected suitable for this subject? (c) Was the material clearly and definitely presented? (d) Would the students be likely to remember it and apply it in the right way? (e) How much originality and resourcefulness did the teacher show in questioning, blackboard work, use of illustrative material, and so on? (f) How much self-reliance, initiative, and self-criticism did the class show? (g) Was the work correlated with other subjects and activities?

*Selection of text and reference books.*—Reference books must be kept up to date. Expensive books may be bought, because a few good ones will be all that is needed. In the selection of reference books, certain points must be observed in their evaluation. These are as follows:

1. Aims: What is the main purpose of the book? Other aims more or less definite? Are the aims desirable? Are they practicable?

2. Subject matter: How far does the selected material help to carry out the aims? Does it meet the needs of the nurses on this subject? Does it cover the ground adequately? What are the outstanding omissions? Is it authoritative? What leads you to think it is or is not? Is it scientifically accurate and up to date? Is the material too advanced or too elementary and superficial for the average group of students?

3. **Organization and presentation of subject matter:** Is the aim clearly stated and held to throughout? Is the material arranged in the best order for teaching; for reference? Does it stimulate thought? Is it well balanced according to relative values? Is the style definite, concise, and clear? Is the material too condensed or too diffuse? Is the book readable? Is it well arranged for study and review? Is it well illustrated? What do the illustrations contribute? Is the general tone of it good?

4. **Appearance and make up:** Is the book attractive in appearance? Is the paper good? Is the type clear and of good size? Is the book convenient to handle size, weight, and so on)? Is the price reasonable?

5. **Summary:** What are the strong features and what are the weaker features of the book? For what purpose is it specially suited?

*Class management.*—The student's intelligence quotient should be known by the instructor for comparison with class rating if her ability is questioned. The student's notes should be corrected during the preliminary term. After that time the notes should be ready and open for inspection at any time. To insure adequate preparation for graduation, drugs, and solutions, the metric system, and the avoirdupois system should be reviewed. The failure in two subjects, regardless of other grades, should constitute grounds for dismissal from the school. The student must know this from the first.

*Correlation of classroom and ward teaching.*—All subjects must be taught in the classroom as they will later be used in the wards. Of what value to the student is a classroom demonstration with perfect, complete equipment when in the wards she may have next to nothing to work with? Baths when taught in the classroom should be given in the wards as practical work. The same is true of all procedures. If a nurse is not given the opportunity to use new knowledge as soon as it is obtained, fully half of its value is lost. Classroom teaching and ward work must go hand in hand if we are to train efficient nurses.

*Records which must be kept by the teacher.*—The teacher must keep a daily class roll, an outline of every course taught, and all incomplete records. In addition, examination questions of the various years, the range of scores of the classes, and all illustrative material must be kept on permanent record by the teacher. Lesson plans should be kept on file, but these need not be permanent, as they really are the teacher's personal property.

In teaching sciences as needed by nurses, such as chemistry and bacteriology, the opinion seems to be that the laboratory work in the

line of experiments may be done by means of a perfect demonstration by the teacher. Nurses need not do individual experiments. In anatomy laboratory work it is of value to the student to do certain experiments in dissecting. By doing them she is able to get a much clearer knowledge of the various parts. *Materia medica* and drugs and solutions should be taught not only in theory but also in the laboratory. Clinical subjects must be taught with due thought to the underlying principles and with ward work and class-work correlated.

The standard curriculum is an excellent guide as to subject matter in general. There is a certain amount of overlapping, but the teacher who makes out lesson plans and who knows definitely the work which she has covered can avoid this overlapping in her own classes. Course outlines, properly made, will serve to help the teacher whose time is very limited, cover the essential points and to touch lightly on such subjects as need not be stressed.

The preceding pages have outlined to a fair degree the work given during the summer session at Columbia University. In addition to the academic work, however, there are other things to be considered. Nurses attending this course make many interesting contacts. From all over the world they meet nurses who are greatly interested in nursing education, and they can not help but get a certain amount of inspiration from them. After hearing some of the difficulties under which many of these nurses work and the enthusiasm with which they carry on, the difficulties they overcome, and the spirit of sacrifice they show, nurses who have not been active in trying to raise the standards of their profession begin to feel somewhat ashamed of themselves. They hear the problems of different groups, learning something of the difficulties of struggling with a hospital board which will not provide funds for proper training and yet demands perfect training and service. They learn that handling student nurses of to-day demands specially trained women and very capable teachers. Nurses of to-day are not just trained, they are educated.

This paper has been written from notes taken during the summer session and from various reference readings. For those who are interested in the subject, a brief bibliography is to be found at the end of this article. In addition to the above sources I am greatly indebted to some of the nurses stationed in New York who patiently listened to my discussion of the papers which had to be handed in and to problems which had to be worked out during the course.

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## NOTES AND COMMENTS

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### THE BUREAU POLICY REGARDING POSTGRADUATE TRAINING

For many years the bureau has been concerned with the question of postgraduate training for officers of the Medical Department. The policy and program have necessarily been modified from time to time to meet the changing needs, the progress of professional standards, the changes of conditions of many sorts.

The bureau has given particular thought to this problem during recent months. In October, 1929, a committee was appointed to study the whole situation and report its findings, together with pertinent recommendations.

Without entering here into the details of this inquiry, it may be said that the findings of the committee crystallized about certain points. It was apparent that certain civilian institutions often fail to provide instruction which is entirely adequate to meet the demands of our present practice of assignment to courses. It was also evident that greater utilization of such service facilities of instruction as the Naval Medical School and naval hospitals could be made with advantage.

As a result of recommendations made by the committee, a special advisory board was created to meet from time to time for further study of these matters and to report its recommendations to the bureau. The board consists of the commanding officer of the Naval Medical School, the personnel officer of the bureau, and other officers whose membership on the board was considered desirable. Among the duties of the board are: The selection of medical officers for postgraduate study after estimating the current needs in the various specialties, considering the individual service records of officers, and ascertaining the budget; the selection of those civilian institutions for instruction which best suit the Navy's needs; the adoption of policies designed to maintain an adequate number of medical officers trained in the specialties required for the needs of the service; the formulation of a program which will include the adoption of a basic course at the Naval Medical School which will fit into the general scheme of the postgraduate policy; and the adoption of measures which will permit young officers to follow to a greater extent their

natural inclination regarding specialties by appropriate assignments in so far as service requirements and other circumstances permit.

No sudden or revolutionary changes are expected or contemplated. The problem is highly complex and the field of operations is surrounded by numerous restrictions and limitations. It is believed, however, that gradual improvements will be realized both in a more adequate supply of specialists needed and in a program that will more fully meet the desires of officers for opportunities of post-graduate training.

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#### THE TREATMENT OF SYPHILIS

In surveying the medical literature of recent months one is impressed with the prominence and space given to articles on syphilis. Many subjects have had their day on the front page of medical journals. Syphilis is occupying a large share of the headlines today. The articles have dealt with all phases of the subject—laboratory diagnosis, pathology, neurosyphilis, and treatment. In all of these branches notable advances have been made in recent years. The *BULLETIN* never appears without at least one article devoted to some aspect of syphilis. This issue contains three articles on as many different phases of the problem. Of particular merit is the contribution by J. E. Houghton on a new laboratory procedure in the diagnosis of syphilis.

The greater number of the articles have dealt with the subject of treatment. Two trends, in particular, may be noted. One is the increasing use of bismuth; the other, the use of smaller doses of the arsphenamines and the employment of many measures in the ever-increasing efforts to avoid arsphenamine poisoning and its often tragic disasters.

An outstanding article, and one widely abstracted and commented upon, is that by Jay F. Schamberg, Bismuth and Neoarsphenamine in Syphilis, which appeared in the October, 1929, number of the *Archives of Dermatology and Syphilology*.

During a period of more than three years in Schamberg's clinic about 20,000 injections of neoarsphenamine were given, with no fatalities, no jaundice, nor any serious complication. This record he attributes essentially to a cutting down in the dosage of the arsphenamines, the exclusion of the old arsphenamine, and, possibly, to the quality of the drug and the technic employed. The dose of 0.6 gm. of neoarsphenamine is never exceeded; commonly 0.45 gm. are given; often 0.3 gm.

Certain disadvantages of neoarsphenamine may be obviated by greater frequency of injection, the employment of proper technic,

and immediate use after preparation of the solution. Although the old arsphenamine has certain advantages, there is no means of avoiding the disadvantages that it possesses.

To quote the International Medical Digest of December, 1929:

An experience of seven years has convinced Schamberg of the remarkable therapeutic activity of bismuth and of its superiority over mercury in the average case. His usual method is to give initially an injection of bismuth (usually 100 mg. of potassium tartrobismuthate) intramuscularly. Three days later the patient receives, intravenously, from 0.3 to 0.45 gm. of neoarsphenamine, depending on his weight, age, and vigor. Each week then for 12 weeks the patient receives one injection of bismuth and one of neoarsphenamine. The dose of neoarsphenamine, when thoroughly tolerated, is sometimes increased to 0.6 gm. for vigorous subjects, but never beyond that dosage. The bismuth is used first in order to avoid a Herxheimer reaction.

In a high percentage of cases the Wassermann reaction of the blood is negative after the first course of the treatment.

Results reported in cases of early syphilis in which the bismuth-neoarsphenamine treatment was used have shown from 50 to 92 per cent of negative Wassermann reactions after the first course.

Schamberg continues the treatment with bismuth and neoarsphenamine until an aggregate amount of about 5 gm. of neoarsphenamine has been administered. Then, if the blood and spinal fluid give a negative reaction, bismuth alone is continued until 2 gm. of the bismuth compound have been injected. This constitutes the first course of treatment. In some cases mercury and neoarsphenamine are used in the second course; in others, bismuth is employed. The clinical results are at least as good, and possibly better, with respect to the reversal of the Wassermann reaction than during the period years ago when weekly doses of from 0.4 to 0.6 gm. of arsphenamine were given; and accidents are infinitely fewer.

In the Lancet of November 9, 1929, Prof. H. Ritter and Dr. C. L. Karrenberg report at length on their experiences with bismuth at the department of dermatology and syphilology, General Hospital, St. Georg, Hamburg. They have abandoned intravenous bismuth as too dangerous and have been using bismogenol intramuscularly during the last six years.

Bismogenol is the insoluble bismuth salicylate in olive oil, and contains about 0.05 gm. of bismuth per c. c. of the suspension. They report with unusual enthusiasm on the excellent results they have obtained with this drug.

In conclusion, these authors remark:

The very great value of bismuth, especially for the treatment of the later stages of syphilis, is undoubtedly due to some extent to the fact that it is a mild and yet durable remedy which serves as a preparation for more intense courses of treatment. It is never followed by the severe reactions which are often seen in the later stages after salvarsan. Bismuth is never contraindicated at the beginning of an antisyphilitic course, with the one exception of early abortive treatment, whereas there are many contraindications to salvarsan in the later stages. On the other hand, bismuth is indispensable in those cases which are hypersensitive toward salvarsan or mercury.

On April 10, 1929, H. C. Solomon addressed the Boston meeting of the American College of Physicians on The Treatment of Neurosyphilis. His paper appears in the November, 1929, number of the Annals of Internal Medicine.

He states that:

1. It is now possible to obtain an apparent arrest in all forms of neurosyphilis.

2. Not all cases of any form or variety of neurosyphilis can be arrested.

3. Febrile methods and tryparsamide are the most effective means available in the treatment of neurosyphilis. Intraventricular, intracisternal intraspinal serum injections, as well as arsphenamin, bismuth, mercury, and iodid, are of secondary importance.

4. The arrest of late and advanced and malignant types of neurosyphilis give strong evidence that when cases are treated earlier they can be arrested before great damage has occurred.

5. Improvement in our methods of treatment is to be hoped for and expected.

He further states that—

Tryparsamide appears to affect the spinal fluid in a favorable fashion somewhat more frequently and somewhat more rapidly than does malaria. In neither case is it possible to offer satisfactory percentage figures, and one will have to be satisfied with such a statement, as just made, as the best conclusion that can be drawn without substantiating figures. My personal experience has been that it is possible to get a completely negative spinal fluid in a considerable percentage of the cases of general paresis, even including the quite far-advanced cases. In dealing with a group of institutionalized paretics who have been in a hospital for one, two, or three years before treatment was instituted we have been able in more than 50 per cent of the cases to get a practically negative spinal fluid. Most of this group of cases were quite deteriorated mentally and showed little, if any, mental improvement. Physically, improvement occurred and, most important, the disease did not seem to progress, the mental condition remained stationary, and the patients have lived for a longer period than would be the ordinary expectancy in such cases untreated.

It must be emphasized that in the treatment of established cases of general paresis neither method gives anywhere nearly as high a percentage of satisfactory results as one desires. It is my personal belief that very often the combination of malaria and tryparsamide will achieve a good result when either alone does not accomplish this. This is a point on which there is a difference of opinion, but personal experience has thoroughly convinced me of the validity of this belief. \* \* \*

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#### GONORRHEA

The Massachusetts Department of Public Health requested Dr. P. S. Pelouze to prepare an article which would represent his views of the minimum amount of knowledge which should be had by any physician who undertakes to treat gonococcus infection in the male.

This Doctor Pelouze has ably done. The article appears in the November, 1929, number of Venereal Disease Information, issued by the United States Public Health Service. Every medical officer should read the article with distinct profit. As to treatment, Pelouze says, in part:

Perhaps the greatest bugbear has been that of treatment, and in no phase of the question is there greater need for simplification. The writings in this regard have been multiplied to the point of confusion. Unquestionably we are far better off if we know one simple plan of treatment and what to expect of it than if we know of a number of plans which we use in the haphazard way that such multiplicity usually engenders.

In gonorrhoea we know almost nothing about the real curative processes and are thrown entirely upon the empiricism of our clinical observation. Both the pathology of the disease and our therapeutic experiences throughout the years seem to show beyond a doubt that local medicinal treatments are valuable for their action upon the infected mucous membranes and not because they may be able to kill gonococci. In fact, gonococci have reached tissue depths well beyond the direct reach of our bactericidal substances. We, therefore, in the present state of our knowledge are in a safer position if we give up the idea of directly killing the gonococcus and view the patient as the one who really cures the disease. We either help or hinder him in the battle, according to the means we use and how we use them. Such being the case, we should be familiar with certain clinical aspects of the disease, as they serve as safe guides in our treatment.

There is much reason to believe that the patient's curative efforts originate largely, if not solely, in the infected mucous membrane, and there are a number of events that retard these curative efforts. We know from years of observation that patients who indulge in sexual excitement and the ingestion of alcohol do not go on to cure, no matter what our treatment may be. It is equally obvious, and often dramatically so, that treatment that can in any way devitalize, irritate, or traumatize the infected mucosa does not promote cure. The same can be said about the use of gonococcus vaccines. So we summarize by saying that our best ally for cure is an untraumatized mucous membrane in a patient who drinks no alcohol, has no sexual excitement, and to whom large doses of gonococcus vaccines are not given.

If the patient is to carry out the treatment, a thing to be avoided wherever possible, he should be made to carry it out in the presence of the physician at least once, so that he may be properly instructed as to its dangers. He should be given a blunt-nozzle glass syringe with a rubber bulb and, after voiding to cleanse his urethral lumen, he should very gently inject not more than 5 c. c. of the chosen solution and should hold it in the urethra for about five minutes. It is rather easy to prove that two carefully given injections in the 24 hours is more beneficial than a larger number.

By far the best method is for the physician to carry out all of the treatment, for it is a fact easy to demonstrate that the frequent contacts between patient and physician are much to the patient's benefit. In no disease are patients more in need of constant repetition of instructions and warnings. The patient who sees his physician once a week is hardly likely to be sufficiently impressed with the importance of pursuing his restrained deportment long enough to avoid those laxities during the quiescent periods that are so influential in bringing about chronicity of infection and in spreading the disease to others.

### THE DIAGNOSIS OF GONOCOCCAL ARTHRITIS

In the *Annals of Internal Medicine* of October, 1929, O. H. P. Perry has contributed an unusually exhaustive and illuminating article on gonococcal arthritis. His paper was read before the American College of Physicians at Boston, April 9, 1929.

He emphasizes the fact that "only when an acute arthritis develops during acute gonorrhoea can one safely and easily make this diagnosis. Under other circumstances, it is usually made with difficulty and doubt."

He discusses separately and in nice detail the value of such diagnostic criteria as history, character of the arthritis, other clinical features, the complement fixation test, Röntgenology; joint puncture, the course of the disease, and the results of treatment.

He concludes that—

1. Gonococcal arthritis is a frequent disease in both males and females.
2. It is protean in its manifestations and may closely simulate rheumatic fever.
3. The true nature of a gonococcal arthritis will often be overlooked unless this etiologic possibility is kept constantly in mind.
4. Diagnosis of this condition is often difficult; the diagnostic methods unsatisfactory when used singly; combined they will usually prove sufficient.
5. It is suggested that a gonococcal focal infection may cause either a specific gonococcal arthritis or a nonspecific infectious arthritis. Many of our diagnostic difficulties may arise from this.
6. There is some reason to believe that rheumatic infection prepares the soil not only for recurrences of rheumatic fever but also for other types of arthritis, including the gonococcal.

An instructive case report of gonococcal arthritis by F. R. Moore appears on page 380 of this issue of the *BULLETIN*.

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### URINARY OBSTRUCTION AND HYDRONEPHROSIS

Waltman Walters and William F. Braasch, Rochester, Minn. (*Journal A. M. A.*, November 30, 1929), report 10 operative procedures performed on 9 patients. Results of 9 of the 10 operations were good. In four cases five hydronephrotic renal pelves were resected. Therefore, in one case operation was bilateral. Four of these five resections were successful; secondary nephrectomy was necessary in the other case. In the case in which resection was bilateral, with an interval of four months between operations, results in both kidneys were excellent. Resection of the hydronephrotic or pyonephrotic portion of a duplicated kidney was performed in three instances. Ureteropyeloneostomy for obstruction at the ureteroplevic juncture was done in two instances. In one of these two cases the obstruction involved a solitary kidney and was acute and complete; in the other the obstruction followed pelviolithotomy performed elsewhere.

**FACTORS INFLUENCING OPERATIVE PROCEDURE IN HYDRONEPHROSIS**

William C. Quinby, Boston (Journal A. M. A., November 30, 1929), reports a case in which a hydronephrosis was found associated with an abnormality of the renal blood supply. The clinical picture presented by such patients is often striking. The symptoms began three years before admission and consisted of an intermittent dull ache in the left loin radiating through to the abdomen. The pain was usually dull, but there also occurred acute exacerbations, with tenderness of the abdomen and of the costovertebral angle and lumbar region. No mass had been noted; lying on the right side aggravated the pain. During the past year attacks had occurred about once a week and were accompanied by nausea and vomiting lasting about 24 hours. At operation a hydroephrrosis was found associated with an aberrant artery lying in contact with the ureter at its junction with the pelvis and anterior to it. After passing the ureter, this artery entered the lower pole of the kidney. It was accompanied by two veins of considerable size. Examination of the hilum of the kidney failed to demonstrate any normal renal artery. The upper pole of the organ was not exposed, but doubtless this portion was also supplied by a similar polar artery. After thorough mobilization of the dilated pelvis, the ureter was cut away and the point of its insertion closed by a few stitches of fine catgut. A point on the pelvis well away from the vessel was then chosen, a linear incision made into its wall, and to this the upper end of the ureter was anastomosed. Following operation there was almost no leaking of urine, and convalescence was entirely afebrile. Five months later the patient reported that she was entirely well. Renal function showed a better output of dye from the unoperated kidney than from the one on which operation had been done, but this difference was not great, and the pyelographic outline of the pelvis on which the plastic operation had taken place showed about a 25 per cent diminution in size, with normal, funnel-shaped outlet.

A quite recent report from this patient nearly seven years after operation tells that she has continued to be entirely well, has married, and has gone through one pregnancy without untoward event. Seven months before entrance the patient had been operated on elsewhere for questionable "diverticulitis." No diverticulum was found, but the appendix was removed. There had never been any symptoms on the part of the bladder or rectum. Recently these attacks had grown more severe and the vomiting had lasted longer. Physical examination was normal except for pain and tenderness on palpation in the region of the left kidney. The urine was normal, as was also the blood. Röntgenologic studies of the gastrointestinal

tract were normal. By cystoscopic examination the bladder was normal and each ureter was free for the passage of a catheter. A pyelogram showed a hydronephrosis of the left kidney with marked blunting of the calices. There was no evidence of stone by Röntgen examination. Quinby suggests that the cause of the hydronephrosis in this group of cases is to be found merely in the pulsations of the artery itself, lying in juxtaposition to the ureter and inhibiting there the normal flow of peristaltic waves. No mechanical obstruction is necessary and none is present, but the current of action set up by each arterial beat is quite sufficient to cause nervous interference in the ureter of a minor degree. Acting thus from the birth of the individual, a slowly increasing dilatation of the renal pelvis ensues. When this reaches a sufficient size symptoms appear. He asks that the operative procedure for the relief of this type of hydronephrosis be based on the following postulates: 1. The aberrant renal artery functions as an end artery the ligation of which means, in effect, a partial nephrectomy. This is undesirable, and should rarely be done except in those instances in which the vessel is extremely small. 2. The hydronephrosis is due to partial inhibition of normal peristalsis by the arterial beat of the apposed vessel. Therefore removal of the ureter to another position on the pelvis out of contact with the vessel, and reimplantation of it in this position is the best method of relief.

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#### STERILIZATION OF INSTRUMENTS IN EMERGENCY SURGICAL OUTFITS

When surgical instruments are infrequently used, as may be the case on destroyers and destroyer tenders, it is desirable, for emergency purposes, to employ some means by which they may remain sterile over long periods.

A method suggested by Chief Pharmacist's Mate E. R. Robinson, United States Navy, in October, 1928, has been thoroughly tested and found to be highly satisfactory.

In this method a solution of phenol, camphor, and liquid petrolatum is used. The phenol supplies the antiseptic properties, the camphor removes the corrosive properties of the phenol, and the petrolatum prevents rusting or tarnishing.

The solution is prepared as follows: Place 20 gm. of phenol crystals in a 500 c. c. graduate. Add 40 gm. of gum camphor, stirring until the mixture is liquefied. Add liquid petrolatum to make the total mixture up to 400 c. c.

The instruments are boiled and dried thoroughly with sterile gauze. The solution is then applied to the instruments by wiping with gauze soaked in the solution. Sharp edges are wrapped with



sterile cotton soaked in the solution. The instruments are then wrapped in gauze which has been soaked in the solution (and wrung out to avoid an excess of the solution). They are then wrapped in packages with waxed paper in order to avoid evaporation of the solution.

Instruments were prepared in the manner described and left on the roof of the naval medical supply depot. Seven months later the packages were opened and contents examined. No rust nor corrosion had occurred.

The antiseptic value of the method was recently tested at the Naval Medical School, with results as follows:

(a) A group of instruments inoculated with staphylococcus aureus and wrapped in sterile gauze and oiled paper. Another group treated in same manner, using *B. coli*. Positive cultures obtained after 33 days from both. Negative cultures obtained from both after 66 days.

(b) Same technic as in (a), except that instruments were boiled after inoculations. Negative cultures after 33 and 66 days.

(c) Same technic as in (b), with additional treatment by the camphor-phenol-petrolatum method. Negative cultures after 33 and 66 days.

(d) Same technic as in (c), omitting boiling. Negative cultures after 33 and 66 days.

(e) Same technic as in (d), using also a package inoculated with *B. subtilis*. Negative cultures from the staphylococcus aureus and *B. coli* packages after 24 hours. *B. subtilis* package remained positive until nineteenth day.

Following these tests, the Naval Medical School reports as follows:

From the above tests it is believed that this modified campho-phenique, if used according to the given technic, will render the ordinary bacteria inert within 24 hours.

For the spore-bearing organisms 19 days is believed the shortest safe period for sterilization.

If the instruments are sterile when prepared with the campho-phenique it is believed they will remain so.

For all hinged or jointed instruments it is very important that the campho-phenique be thoroughly worked into such hinges or joints.

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#### LACK OF THERAPEUTIC VALUE OF ANTIMENINGOCOCCIC SERUM

J. Mercér Anderson, Salt Lake City (Journal A. M. A., November 23, 1929), states that the ordinary commercial antimeningococcic serum was therapeutically inadequate in the treatment of 60 cases of the epidemic type of cerebrospinal meningitis. The first 10 cases

were 100 per cent fatal, some patients dying in less than 18 hours and other lingering for days. Of the 60 patients, 32 lived and 28 died, giving a mortality of approximately 47 per cent. Nine patients died in less than 24 hours from the time of admission to the hospital. As soon as a diagnosis was made large amounts of serum were given intravenously and intraspinally. In addition, some patients received it intracisternally. Treatment was given two or three times daily during the first 72 hours. Serum was not given intravenously after the second day, except in one case. Because of the great fatality of the early cases, antimeningococcic serum was secured from the public health department of one of the larger States. This serum seemed to give much better results because of such patients as received the serum, 21 in all, 14 lived and 7 died, giving a mortality of 33.3 per cent. In those patients receiving it alone the mortality was 29 per cent. Among patients who did not receive this serum the mortality was 54 per cent, or 21 per cent higher than among those receiving the special serum. This greatest mortality was found in cases which were fulminating—the patients dying in 24 hours or less from the time of admission. This group included 9 cases—2 patients not receiving any serum and 7 receiving only one treatment. Several patients died before they could be brought to the hospital.

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#### **SYMPTOMATOLOGY ASSOCIATED WITH HEPATIC DYSFUNCTION**

C. W. McClure and M. E. Huntsinger, writing in the November 21, 1929, number of the *New England Journal of Medicine*, report on some interesting, and perhaps important, observations they have made in the studies of liver function.

“The patients described above fall into three groups—one characterized by nausea and vomiting, a second by pain resembling that of gallstone colic, and a third by symptoms of peptic ulcer. They were all characterized by the absence of demonstrable organic lesions.”

Some of these patients had undergone cholecystectomy without relief; some were affected with toxic jaundice; in others there was no apparent organic cause for the symptoms. In those without apparent organic cause the symptoms suggested either functional neuroses, gall-bladder disease, or peptic ulcer.

“The symptomatology of the patients ordinarily grouped under the classification of functional neuroses was comparable to that of those affected with toxic jaundice. The symptoms of those resembling organic disease was comparable to those occurring in the patients who had undergone cholecystectomy.”

They summarize their findings as follows:

The presence of hepatic dysfunction in the groups of patients studied suggests that their cases may all be classified as metabolic disorders.

The findings indicate that patients presenting the symptoms of functional neuroses may actually be suffering from disturbances in the functional state of the liver. The symptoms were usually manifested at a comparatively early age and tended to become chronic in nature.

Symptomatology, characteristic of common intraabdominal lesions, has been described which occurred in the absence of demonstrable disease. Such symptomatology is interpreted as resulting from disturbances in the functional state of the liver. The findings emphasize the advisability of seriously attempting to demonstrate an organic lesion before considering laparotomy.

The findings indicate that liver functional disturbances are one cause for the continuation of symptoms which may follow surgical operations on the gall bladder. For this reason, before operating it is advisable to consider what rôle hepatic dysfunction may play in the production of the symptoms manifested.

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#### CODMAN'S REGISTRATION OF BONE SARCOMA AND ITS BEARING UPON A STUDY OF MALIGNANCY ELSEWHERE

J. C. Bloodgood, writing in the *New England Journal of Medicine* of November 14, 1929, believes that: "Chronic cystic mastitis should be subjected to the same searching investigation as Codman did with bone sarcoma. There is no doubt that Codman's registry excited great interest in this country and Canada, and the literature arising from this stimulation influenced the entire medical world to pay more attention to bone tumors."

Codman's method was to submit to a committee of pathologists the tissue sections and case records of all patients who had survived five years after an operation for bone tumor which was diagnosed as sarcoma. A relatively small per cent of the cases were verified sarcoma. He recommends a similar method of study for other types of tumors.

By this method it will be discovered that there are many characteristics of nonmalignant growths which may be used to identify them as benign. They may be used as operative indications and as prognostic criteria. Since 1902 the proportion of breast lesions in Bloodgood's clinic for which operation is not indicated has increased to 65 per cent from 1. "In the group of cases of lumps in the breast in which operation is indicated THE PER CENT OF CANCER HAS FALLEN in 30 years from 80 to 17 per cent."

The distribution of information in regard to cancer through the influence of the American Society for the Control of Cancer and Codman's Registration of Bone Sarcoma has been coincidental with an increase of the 5-year cures of bone sarcomas from less than 4 to more than 35 per cent. The earlier a bone lesion comes under observation the more difficult the diagnosis in the X ray or in the biopsy.

I also wish to add the following figures in relation to lesions of the oral cavity, skin, breast, and nodules to be felt beneath the skin. The relative proportion of these various lesions since 1925 as compared with the first decade up to 1900 is that in every locality—breast, skin, etc.—we see 100 patients where before we saw only 35. The incidence of cancer in these cases to-day is 17. In the early decade it was 80. The cures of cancer in 1900 in these localities were less than 10. To-day they are more than 60. The per cent of lesions that are not malignant and for which operation is not necessary has increased from less than 1 to more than 65 per cent. In the cases of local lesions which must be subjected to operation the benign group has increased from 20 to 50 per cent and the malignant group has decreased from 80 to 50 per cent. There seems no question that any activity which leads to publicity and gives the correct information to the people and to the medical profession increases the cures of cancer. The complete control of cancer rests upon research.

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#### SOME NEEDS IN MEDICAL BIBLIOGRAPHY

Archibald Malloch, librarian of the New York Academy of Medicine, addressed the Medical Library Association at Cleveland, September 3, 1929, on Some Needs in Medical Bibliography. The address appears in the November, 1929, number of the Bulletin of the New York Academy of Medicine.

In mentioning useful lists of reference books he spoke in praise of the exhaustive list of biographies recently compiled by Colonel Garrison. He suggests the compilation of a list of Useful Reference Books for a Medical Library after the fashion of Miss I. E. Mudge's New Guide to Reference Books.

He stresses the importance, in such compilations, of including both subject indexes and indexes to authors.

Concerning the rumor that the third series of the Index Catalogue of the Surgeon General's Library will be the last to be published, Doctor Malloch remarks:

"I do not believe that the Government of any other country ever supported such a piece of wonderful bibliographical work, but unless Congress can be urged to continue the *Index Catalogue of the Surgeon General's Library*, at least in the form of the earlier volumes of the third series, there is a dark and gloomy outlook for the medical research worker and writer of the future, not to speak of the staffs of medical libraries. The year 1950 is not a great way off; let us consider how we should look up what had been written on a subject if the *Index Catalogue of the Surgeon General's Library*, as we know it, had ceased to exist. First of all we should go through the three series of the *Catalogue* and then to cover a score or so of years we should have to look through two volumes of the *Quarterly Cumulative Index Medicus* a year, and all the yearbooks of the Surgeon General's Library. Let us do all we can that only the highest ideals

in bibliography shall prevail and that the work of Billings and Fletcher, so well carried on now by Garrison, shall be continued year by year, step by step \* \* \*.”

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The Journal of the American Medical Association, in its issue of December 7, 1929, prints an editorial on the Quarterly Cumulative Index Medicus. This editorial reflects so well the sentiment of all persons interested in medical bibliography that it is copied below in full:

“A few years ago the headquarters of the American Medical Association undertook to perpetuate, for the advancement of medical science, the *Index Medicus*, for many years the only available index to the medical periodical literature of the world. On several occasions it has pointed out in these columns that the *Index Medicus*, from the time when it was founded by Dr. John Shaw Billings, through the period when it was maintained by Dr. Robert Fletcher, through the vicissitude of a later period, was never a complete index to all medical literature. The attempt to index regularly the potboilers that fill the commercialized periodicals of the European countries, the fly-by-night journals of some of the South American countries, and particularly those so-called gazettes, journals, briefs, councils, times, and what not that infest our own country, has seemed to the editors of every scientific index a waste not only of time but also of money. Many of these sheets are looked over, but they are not overlooked. Unfortunately, their contents rarely seem to demand inclusion in any index that aims to represent medical progress. There never was, moreover, an index of the medical literature of the world that could be made to sustain itself, let alone yield a profit. The *Index Medicus*, published quarterly, never complete, cost the Carnegie Institution around \$20,000 a year and was sold to an extremely limited audience. When the American Medical Association took over this publication in 1927 and combined it with its own highly successful *Quarterly Cumulative Index* a complete index to some three hundred of the leading medical publications of the world, the Carnegie Institution agreed to aid in the maintenance of the combined venture, but only temporarily.

“It was the belief of the directors of the Carnegie Institution that the publication of such an index was the duty of the medical profession. They promised, therefore, only \$10,000 a year for a term of five years, with the hope that the American Medical Association would be able, by the end of that time, through efficient management and promotion, such as has characterized the other activities of the association, to fit the *Index* into its annual budget. From the

first it has been realized that the *Index* would never be a self-sustaining venture. The subscription has been built to approximately five times the number of subscribers that supported the old *Index Medicus*. The subscription rates have been kept low. The work has been expanded so that multiple indexing of every worthwhile contribution in the field of medical periodical literature is assured. The maintenance of a staff in the Army Medical Library in Washington and of a large staff in the headquarters office in Chicago represents a considerable drain on the finances of the association. The actual facts of the matter are that the *Index* costs the association from \$25,000 to \$30,000 a year and that the termination of the agreement with the Carnegie Institution will add another \$10,000 to this total. The contribution is not begrudged; the trustees of the association look on it as one of the finest of the many efforts that the association makes to aid world progress in medicine and it has received for the most part the appreciation of the medical world. German, Italian, British, and French periodicals have added their encomiums for this publication to the many that have come from American leaders. The sad aspect of the matter is that the steady maintenance of this altruistic scientific work should have to pause, even for a moment, to hearken to the buzzing of flies on the chariot wheels, which want to know where the vehicle is going."

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#### HEALTH CONDITIONS THROUGHOUT THE WORLD

Surg. Gen. H. S. Cumming, of the Public Health Service, has recently submitted to Congress a report which summarizes in an interesting way the health conditions throughout the world during the past fiscal year. This report indicates that one of the important public-health duties of the Federal Government is the prevention of the introduction and spread of infectious diseases in the United States from foreign countries. Due to the close relation of commerce to the public health in connection with the spread of epidemic diseases, it has been necessary for the Public Health Service to keep advised currently as to the prevalence of diseases not only in the United States, but in so far as practicable throughout the entire world.

A constant interchange of sanitary information with other nations of the world was in effect through the International Office of Public Hygiene of Paris, the Pan American Sanitary Bureau, and the Health Section of the League of Nations. Important epidemiological information was also received by the Public Health Service through American consuls, officers of the service stationed abroad, and directly from foreign governments.

Any generalization as to the mortality rate for the world must be in relative terms, since the rate of mortality varies so widely in different countries. For example, the death rate in India or China, or even certain European cities, is several times as high as that in the United States or in most European countries, a fact that in itself constitutes impressive evidence of the results of modern medicine and public-health administration.

There occurred in the winter of 1928-29 an epidemic of influenza which, although mild as compared with the epidemic of 1920 and the pandemic of 1918-19, reached a large part of the countries for which mortality records are available. In the United States the epidemic began on the Pacific coast as early as October, 1928, with a peak of the reported cases early in December, and gradually spread eastward with the peak of cases in the New England States about six or seven weeks later. From June to November, 1928, outbreaks had appeared in several Pacific islands. In fact, in the late spring of 1928 there occurred in the United States a considerable number of influenza and pneumonia deaths in excess of the normal expectancy.

The epidemic appears to have reached its peak in most European countries in February, 1929, one or two months later than in most of the States of the United States. The first outbreaks reported in Europe were in Ireland in September, coming to a peak in November, but Ireland suffered a secondary wave in February, when the disease was at its height in the remainder of Europe. The attack rates varied widely from one region to another. In some places the general death rate (all causes) was scarcely affected; in others the maximum weekly death rates were very heavy. These death rates exceeded somewhat the highest rates in American cities. In England and Wales the death rates were the highest since the 1918 pandemic, but in the Soviet States, Austria, Hungary, and Switzerland the recent peaks were considerably below those of the epidemic which visited certain European areas in 1927.

Cerebrospinal meningitis was unusually high in the United States during the last half of 1928 and especially during the early part of 1929. Up to the beginning of 1929 there was no undue prevalence of the disease in European countries, but in April and May of 1929 there was more than the normal number of deaths from this disease in England and Wales, Scotland, Germany, and Italy. In the last preceding high period (1915-18) the disease appeared in Europe earlier than in the United States, but the reverse was true in the present period of high prevalence.

There was in the fall of 1928 an epidemic of plague in India, particularly in the Bombay Presidency, which was the most severe since 1923. In the early months of 1929 the plague situation in

nearly all parts of the world appeared to be more favorable than in previous years. The disease did not occur on vessels arriving at the United States ports during the year, although it continues to prevail in certain South American countries, and during the fiscal year it appeared in Argentina, Brazil, Ecuador, Peru, and Uruguay.

A considerable number of cases of cholera occurred in India during the year. In such a disease as cholera, which occurs in great epidemics, a single year's record has little significance so far as the trend of the disease is concerned. Considering the various years, there has been a noteworthy decrease of cholera in India during the past 10 years.

Yellow fever was reported in Brazil during the year, a severe outbreak occurring at Rio de Janeiro. At the close of the fiscal year the outbreak appeared to be under control, but at that time the disease was reported in the interior of Colombia. These occurrences prove that notwithstanding the progress which has been made in the fight against yellow fever constant vigilance is still necessary to prevent this scourge from again securing a foothold in the United States.

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#### THE EXTENT OF ILLNESS IN THE UNITED STATES

In the December 7, 1929, number of the Journal of the American Medical Association appears an editorial which contains so much information of unusual interest in regard to present health conditions in the United States that it is included below in full:

"Huxley described the great tragedy of science as 'the slaying of a beautiful hypothesis by an ugly fact.' A wide variety of views is offered regarding the problems of the medical profession in relation to the public. The adequacy of existing curative and preventive medical services and their effectiveness are being questioned. To these problems the Committee on the Cost of Medical Care is giving careful consideration. It has become imperative to secure facts lest a tragedy of errors supervene. The Commission on Medical Education, organized under the leadership of President Lowell, of Harvard University, has already reported an extensive study of the demands and needs for medical service, in part by sampling the demands on general practitioners in communities small enough to give a clear picture of general practice. The preliminary surveys, to which references have already been made in the Journal, indicated that about 75 per cent of the office visits were for minor surgery, upper respiratory infections, and general medical and venereal diseases. About 90 per cent of home visits were for infections of the respiratory tract, general medical and contagious



diseases, obstetrics, and minor surgery. More than 90 per cent of the illnesses are of types that can not be controlled on a community basis but are problems of individual patients. Less than 10 per cent are diseases against which public-health efforts are mainly directed. This fact is an index of the growing efficiency of public-health efforts and emphasizes the necessity of treating the patient as well as the disease. The common causes of disabling illnesses and absenteeism correspond closely with 80 per cent of the combined office and home visits of the general practitioner.<sup>1</sup>

“The dulness of ordinary statistics is lost in some of the discoveries of the Committee on the Cost of Medical Care. They indicate for this country that people are, on the average, disabled by illness at least once annually, men about once a year, women from once to twice, and children more than twice each school year (of 180 days).<sup>2</sup> On the basis of the lowest rate for disabling illness found by the United States Public Health Service, there would be about 130,000,000 cases of disabling illness in the United States each year and, if nondisabling illnesses should be added, this figure would be more than doubled. What this may mean is indicated by the conclusion that the 36,000,000 wage earners in the United States lose at least 250,000,000 workdays a year and the 24,000,000 school children 170,000,000 days each school year. These figures take into account only half of the total population.

“Numerous surveys have indicated that colds and bronchial conditions and influenza and grip are obviously the most serious causes of disability from the standpoint both of frequency and of days lost. On the basis of both the number of cases and the total time lost, digestive diseases and disorders loom large. Diseases of the pharynx, tonsil, and larynx—including adenoids, tonsillitis, sore throat, and croup—are also of considerable frequency and severity. The non-venereal diseases of the genito-urinary system and adnexa receive prominence in the list largely because of the frequency of cases of dysmenorrhea among women and girls; but included are acute and chronic kidney diseases, which each year cause an increasing percentage of the total mortality. It may not be an agreeable reminder, but the medical profession must nevertheless face the warning that in 1928 there were nearly 2,000,000 births in the registration area, many of them followed by complications and a considerable number (a larger proportion than in most civilized countries) by death. On the other hand, the public, and particularly a small obstructive group

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<sup>1</sup> Preliminary Report of Commission on Medical Education, January, 1927.

<sup>2</sup> Mills, A. B.: *The Extent of Illness and of Physical and Mental Defects Prevailing in the United States*, abstract of publication 2 of the Committee on the Cost of Medical Care. Peebles, A.: *A Survey of Statistical Data on Medical Facilities in the United States*, abstract of publication 3 of the Committee on the Cost of Medical Care, 910 Seventeenth Street, Washington, D. C.; the data quoted are taken from these preliminary surveys.

of antivaccinationists, should properly bear much of the odium of more than 36,000 cases of smallpox reported in a recent year. According to these compilations, special estimates place the number of persons in the United States who are mentally defective (feeble-minded, imbeciles, and idiots) at more than 900,000, the number of blind at more than 100,000, the number with major speech defects at 1,000,000, and the number of school children wholly or partly deaf at 3,000,000.

"This country is by no means oblivious of the great problems here presented. There are in the United States more physicians per thousand people than in any other country in the world. Hospital beds and clinics show rapid rates of increase, clinics having the most spectacular growth of all. Hospitals other than those for nervous and mental diseases contain, on an average, more than 350,000 patients at all times. The total in all hospitals on a single 'average' day is about 700,000. Such striking figures, even with their admitted incompleteness, justify the reminder of Mills of an extent of illness and physical and mental defectiveness in the population which causes an incalculable amount of human suffering and economic loss. Some of these diseases and conditions, Mills adds, rob the Nation's people of their vitality and destroy their efficiency; others lead to sudden death and the premature cutting off of life. This continuance of disease, part of it preventable, indicates a field for the more widespread and efficient utilization of preventive and curative measures now known."

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#### CURRENT STUDIES ON MALARIA-CONTROL MEASURES

An interesting summary of current malaria studies of the Public Health Service, with special reference to control measures, has recently been prepared. Reports indicate that during the last three years malaria has increased both in amount and in severity in the Southern States. On the Atlantic seaboard this increase is limited to the area south of North Carolina and in the Mississippi Valley south of Kentucky. Although the malaria rate has been steadily falling for many years, the reduction in 1925 was not very great and no apparent reduction occurred in 1926. In 1927 there was an upward trend and in 1928 this became very marked. The reporting of malaria is so incomplete and the various measurements of malaria prevalence are so inadequate that only the trend of the disease can be indicated without being able to give exact figures. In areas where malaria is well reported the reports of physicians show a very large increase in the number of cases; in a number of States the death rates have risen sharply. A few circumscribed epidemics have been

reported and investigated in a number of States. Here and there the severer forms of malaria have suddenly appeared. Several deaths from acute malaria have been reported.

During the last two years blood examinations have been made in a number of places. Infection rates varying from a little below 8 to as high as 45 per cent have been found in blood specimens taken in the spring and late fall. One county in a rural section gave a rate of 33 per cent.

Malaria has always been heaviest in rural districts. Most malaria-control work, however, has been urban. Heretofore the cost of controlling mosquito production in a town with a population of 1,000 has been about equal to the cost of controlling mosquito production about a single farmhouse. Rural inhabitants found this too expensive even to contemplate. Research in the field of malaria control has had as its primary objective a search for easier and less costly methods.

Recently there have been improvements in the drugs used in the treatment of malaria. However, it is not necessary to wait for the general wholesale use of any drug. Malaria can now be controlled in country districts by other means. Screens have been utilized by the well-to-do for years, but, because of their cost, they have not been put on the poorly-built farm homes or rickety tenant shacks. The problem of screening such homes was attacked by the Public Health Service with gratifying results. The rural screening program developed by the service is now in effect in five or more States and was used in the post-flood public-health work throughout the lower Mississippi Valley.

There is another method of attack against malaria—the prevention of the production of the malaria-carrying mosquito by means of Paris green as a larvicide. The Public Health Service has devised an economical method of distributing this dust. An inexpensive gasoline-driven electric generator was used. This was wired to a light dust gun which, in turn, is connected by a flexible hose to a simple dust hopper. The whole outfit can be carried along with an outboard motor in a light motor car and can be set up by one man in a light rowboat. The dust gun creates a cloud of Paris green and hydrated lime, the mixture used having a Paris-green content of 15 per cent. The dust drifts in the wind and is known to kill larvae over 600 feet distant. This method has been successfully used with outboard-motor speeds of 10 to 15 miles per hour.

One person using the above outfit and a few laborers with hand-power knapsack dust guns can prevent the production of mosquitoes from all or nearly all of the producing areas in a county at a cost within the reach of most counties.

The power duster is also in use on lakes impounded for hydroelectric purposes. Most of the ponds were cleared at great cost, leaving only a narrow rim of flottage at the shore line in which *Anopheles* production occurred. This rim of flottage was removed during the breeding season by lowering the pond level at the commencement of summer, thus stranding the débris and leaving a clean mud bank. However, this fluctuation soon became too wasteful of power and a compressed air-oil-mixture was substituted. Now the power duster still further reduces the cost of shore-line control.

Still further studies to reduce the cost and promote the efficiency of malaria control are being conducted by the Public Health Service.

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#### COMPOSITION OF CIGARETTES AND CIGARETTE SMOKE

The moisture content of tobacco, according to Emil Bogen, Cincinnati (Journal A. M. A., October 12, 1929), varies with changes in the humidity of the surrounding atmosphere from less than 8 to more than 50 per cent of its weight. The moisture content of a score of brands of cigarettes, as taken from the package, was found to average 12 per cent. The inorganic ash remaining after combustion of the cigarette was determined for more than 60 different brands and found to be quite consistently related to the source of the tobacco. It bears, in general, an inverse relationship to the nicotine content of the cigarette. The pure domestic varieties yielded less than 12 per cent of their weight as ash, while the West Indian cigarettes gave as high as 18 per cent. Medicinal cigarettes, such as cubebs, containing no tobacco, yielded less than 10 per cent of their weight as ash. About a hundred determinations of the nicotine content of different cigarettes were made by means of the silicotungstic-acid method. Domestic cigarettes contained the highest concentration of nicotine, averaging about 2.5 per cent. The West Indian brands, on the other hand, contained the lowest nicotine content of any tobacco tested, generally under 1 per cent. The oriental cigarettes had from 1.25 to 1.5 per cent nicotine and the blends or mixtures of domestic and oriental tobacco, which constitute the majority of the popular brands, vary from 1.5 to 2.5 per cent. Naturally the cubebs and other forms of cigarettes containing no tobacco showed no nicotine at all on analysis, but the so-called denicotinized cigarettes contain more nicotine than do some of the West Indian varieties and little less than the ordinary oriental brands. It is apparent, therefore, that simply by choosing the brand of cigarette to be used the amount of nicotine to which the smoker is exposed can be materially increased or reduced. The nicotine, however, is not the only injurious agent to be found in cigarette smoke. Local

irritation from the aldehydes formed during the combustion, from ammonia produced from other nitrogenous substances during the course of the smoking, and from the heat of the smoke itself, as well as the irritating tarry substances comprising the so-called tobacco oil, may not be disregarded.

Headaches and other effects of inhalation of carbon monoxide and lack of oxygen, and the effects of changes in the acidity of the smoke, should not be overlooked. These substances, as well as many others to be found in cigarette smoke, may not be discovered in the unburned tobacco, and it is only by analysis of the smoke itself that they may be investigated. The temperature and the physical and chemical effects of the tarry constituents of the smoke must also be considered. The length of the stump, or the amount of cigarette left unburned, is another factor of considerable importance. The amount of nicotine and other materials removed from smoke by passing through the tobacco of the unburned part of the cigarette varies with the amount of the smoke so passing, and its concentration, as well as with the dryness of the smoke, the rate of suction, the temperature of the smoke and of the tobacco, the length of the stump, the fineness of the particles of tobacco, and the firmness of the packing, and so forth. The amount of nicotine found in the stump of a cigarette which had been smoked with a strong continuous suction to the two-thirds mark was found to have increased by 4 mg., or 66 per cent, over the average nicotine content of this brand of cigarettes. When an intermittent suction of one second puffs of 66 c. c. each every 30 seconds for five minutes was used, the increase amounted to only 15 per cent. A number of stumps of these cigarettes actually smoked by subjects in the course of the blindfold test studies were analyzed and found to contain 16 per cent more nicotine than the average for these cigarettes; in other words, about 1 mg. of nicotine had condensed in the stump of each cigarette during the smoking of about half of it. The temperature of the smoke after passing through the unburned tobacco in half the length of the cigarette is never greater than that of the human body. When only a fourth of the cigarette is left unburned, however, the maximum temperature of the smoke after passing through it may exceed 60° C. (140° F.), and so injure the tissues of the mouth and throat. Moreover, the smoke passing through the unburned stump at such high temperatures is apt to carry with it into the throat much of the nicotine and other condensed substances which, as has just been described, are deposited in the tobacco of the stump during ordinary smoking.

Different cigarettes all gave the same range of temperatures when smoked at exactly the same rate, and changes in the rate of smoking seemed to be effective only in accelerating or retarding the time

required to reach the critical region of the cigarette at which the temperature rapidly rises, but which remains at about the same spot in every case. In order to avoid the irritation from hot smoke and the increase in the toxic agents which such smoke may carry, it is advisable never to smoke a cigarette down much beyond half its length. The chemical composition of the cigarette and of its smoke are not the only factors that affect the physiologic response of the smoker. Inhalation of the smoke so that it may condense on larger surfaces than merely the mouth cavity, and its passage over the mucous membranes of the nasopharynx and the lower respiratory passages, is naturally followed by a greater deposition and consequent absorption of nicotine and other components than results from simply puffing the smoke in and out of the fore part of the mouth. While smoking after mealtime may relieve nervous strain, increase digestive secretions, and allay appetite in a harmless manner, the use of the cigarette before meals is apt to impair appetite and interfere with the normal stimuli to the digestive processes, resulting in the production of various dyspeptic symptoms. Under ordinary conditions, many competent observers have failed to note any deleterious effects whatever from the use of cigarettes. Certain conditions, however, have been so frequently associated with the practice of smoking that the causal connection seems indisputable. Cardiac arrhythmias, shortness of breath, thromboangiitis obliterans, nicotine amblyopia, and chronic inflammations of the upper respiratory passages are familiar examples. Different brands of cigarettes differ widely in the proportions of their constituents, and differences in the manner of smoking may greatly modify the composition of the smoke they yield.

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#### ANNUAL MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

The fifty-ninth annual meeting of the American Public Health Association will be held in Fort Worth, Tex., during the week of October 27, 1930, with the Hotel Texas as headquarters.

The annual meetings of this oldest and strongest of public-health organizations brings together for a week of scientific discussion all of the public-health leaders of the continent. It is always the most important health convention of the year. Health officers, nurses, dieticians, sanitary engineers, child and industrial hygienists—all of the specialists that make up the public-health profession—meet to consider their common problems. Each of the 10 sections of the association—health officers, laboratory, vital statistics, public-health engineering, public-health nursing, public-health education, food,

drugs and nutrition, industrial hygiene, child hygiene and epidemiology—arrange an individual program, and there are a number of general sessions to which the public is invited.

Detailed programs of the Fort Worth meetings will be announced in the official publication of the association—The American Journal of Public Health and the Nation's Health. Further information may be obtained from the executive secretary, Mr. Homer N. Calver, 370 Seventh Avenue, New York, N. Y.

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## BOOK NOTICES

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Publishers submitting books for review are requested to address them as follows:

The Editor,

UNITED STATES NAVAL MEDICAL BULLETIN,  
Bureau of Medicine and Surgery, Navy Department,  
Washington, D. C.

(For review.)

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**DISEASES OF THE CHEST AND THE PRINCIPLES OF PHYSICAL DIAGNOSIS**, by *George William Norris, A. B., M. D., Professor of Clinical Medicine in the University of Pennsylvania; Chief of Medical Service "A," Pennsylvania Hospital; Erstwhile Colonel, M. C., U. S. Army; Colonel, Med. O. R. C., U. S. Army and Henry R. M. Landis, A. B., M. D., Sc. D., Professor of Clinical Medicine in the University of Pennsylvania; Director of Clinical and Sociological Departments of the Henry Phipps Institute of the University of Pennsylvania; Visiting Physician to the White Haven Sanatorium*, with a chapter on the **TRANSMISSION OF SOUNDS THROUGH THE CHEST**, by *Charles M. Montgomery, M. D., Formerly Physician to the Phipps Institute, Philadelphia*, and a chapter on the **ELECTROCARDIOGRAPH IN HEART DISEASE**, by *Edward B. Krumphaar, Ph. D., M. D., Professor of Pathology, University of Pennsylvania, School of Medicine*. Fourth edition. W. B. Saunders Co., Philadelphia, 1929. Price, \$10.

The book is all, and more than, its name implies. As it covers a very large field of medicine, it is necessarily a rather large book, almost a thousand pages.

It is the latest and, quite probably, the best work on the subject. Medical officers whose work lies either largely or partly in this field can find no better reference or help.

As the book was meant for the clinician, clinical methods have been especially emphasized. Most of us will not hesitate to agree with the authors in their opinion that "in the great majority of instances laboratory aids are corroborative and not diagnostic."

Much is included on the subject of diagnostic acoustics because the authors believe that "only through the comprehension of the laws of sound production and transmission can the results of percussion and auscultation be intelligently interpreted."

Illustrations and diagrams are to be found on almost every page and help the reader materially in grasping the text. Many of the photographs are from frozen sections.

The book is divided into four sections: The Examination of the Lungs; The Examination of the Circulatory System; Diseases of the Bronchi, Lungs, Pleura, and Diaphragm; Diseases of the Pericardium, Heart, and Aorta.

The treatment of all these subjects is absolutely exhaustive and leaves nothing to be desired.

Throughout the book one is struck with the success of the authors in carrying out their desire to "omit everything not of practical use and to condense methods of secondary importance."

RECENT ADVANCES IN MEDICINE, by *G. E. Beaumont, M. A., D. M. (Oxon.), F. R. C. P., D. P. H. (Lond.), Physician, with charge of Out Patients, Middlesex Hospital, etc., and E. C. Dodds, M. V. O., M. D., Ph. D. B. Sc., M. R. C. P. (Lond.), Courtauld Professor of Biochemistry in the University of London, etc.* Fifth edition. P. Blakiston's Son & Co., Philadelphia, 1930.

The reviewer of this book is of the opinion that it would be impossible to compress within approximately 400 pages more useful information for the physician than is contained in this volume of that size.

Although the authors are British, American sources, as well as those of France and Germany, have evidently been carefully searched and the most valuable material which has appeared in them in recent years, dealing with clinical, laboratory, and therapeutic technic, incorporated.

Many of the tests and procedures described are necessarily complicated in nature, but all are described in such a way as to be easily intelligible to the average physician.

Especially valuable are the sections which treat of the types of nephritis and glycosuria.

This book may safely be recommended for study by all who practice medicine.

THE VOLUME OF THE BLOOD AND PLASMA IN HEALTH AND DISEASE, by *Leonard G. Rountree, M. D., and George E. Brown, M. D., with the technical assistance of Grace M. Roth.* W. B. Saunders Co., Philadelphia, 1929.

The Volume of the Blood and Plasma, by Rountree, Brown, and Roth, is a new book in which is discussed the experimental work of these three authors and the clinical application of their findings.

It details their approach experimentally to determine the volume of the blood and plasma and explains their reasons for selecting the dye method over other methods for this determination.

Next the normal findings are derived and the fluctuations therefrom due to environmental temperature are discussed. In this chapter

also is an interesting finding of theirs regarding the relation of the weight of the blood to weight of the body.

In the chapters that follow a study of the volume of the blood and plasma is discussed in diseases of the blood, spleen, and liver, various types of edema, diseases of the vascular system, diseases of the endocrine glands, and a few miscellaneous diseases. Following this is a good discussion of clinical data.

The blood is dealt with as a definite living organ rather than as a simple carrier and in this way much interest is aroused over the probability of disease of this organ.

The book goes into detail with the statistical reports of the work of these three authors and very thoroughly covers this subject which is as yet a clinical infant.

**DISEASES OF THE STOMACH**, by *Max Einhorn, M. D., Emeritus Professor of Medicine at the New York Post-Graduate Medical School and Hospital; Consulting Physician to the Lenox Hill Hospital, New York.* Seventh Edition. William Wood & Co., New York, 1929. Price, \$6.

Having recently refreshed my memory by rereading Beaumont's Experiments and Observations, it is, indeed, interesting to pick up the seventh edition of Doctor Einhorn's work and compare the marvelous progress made in diagnosis and treatment of diseases of the stomach with the pioneer work of Beaumont. The detail with which Doctor Einhorn describes his various subjects and the discussion of the functional disturbances of the intestinal canal and their relationship to the presence of gross pathology makes the book of great value to the clinician.

Most of the first part of the book, devoted to laboratory diagnosis and to the use of special apparatus, can only be of use to the specialist, but the dietetic treatment and general management of cases is of value to all. The book is written in a lucid style, is easy reading, and gives us an expert's opinion on the latest developments in gastrology.

**THE BLOOD PICTURE AND ITS CLINICAL SIGNIFICANCE (INCLUDING TROPICAL DISEASES)**, by *Prof. Dr. Victor Schilling, Physician in Chief, The First Medical University Clinic, Charite Hospital, Berlin.* Translated and edited by *R. H. B. Gradwohl, M. D. Director of the Pasteur Institute of St. Louis and the Gradwohl School of Laboratory Technique, St. Louis; Lieutenant-Commander, Medical Corps (Fleet), U. S. Naval Reserve.* Seventh and eighth edition. The C. V. Mosby Co., St. Louis, Missouri, 1929. Price, \$10.

Doctor Victor Schilling has simplified Arneth's complex classification of leucocytes by dividing the neutrophilic cells into myelocytes, juveniles (metamyelocytes showing slight indentation of the nucleus), stab or band forms (with deeply indented nucleus but no true lobulation), and segmented forms. Arneth's term "the shift

to the left" (the emigration of young neutrophilic cells from the marrow into the blood stream in infection) is retained but the further classification of the segmented forms as to number and shape of the lobes has been discarded as of no practical value.

By means of hemograms and differential curves, Schilling shows that three phases occur during the course of an acute infection. 1. "Neutrophilic battle phase," in which immature neutrophiles increase in proportion to the severity of the infection, with decrease or disappearance of eosinophiles and monopenia. 2. "Phase of monocytic defense or subjection," characterized by receding neutrophilia and shift, reappearing of eosinophiles, rising number of lymphocytes and high number of monocytes. 3. "Phase of lymphocytic cure," with lymphocytes, eosinophila, and no shift of the neutrophiles.

Hematological technic, cellular morphology, and blood findings are treated in detail, as well as what is probably the most interesting, a large section devoted to case histories of a wide variety of diseases illustrated by hemograms.

The illustrations, curves, and colored charts are a valuable feature of the book.

Doctor Gradwohl deserves great credit for undertaking the arduous task of translating and placing before the English reading physicians a differential blood count method of great diagnostic and prognostic aid, which should become an indispensable part of every complete blood count.

*ARTHRITIS AND RHEUMATOID CONDITIONS*, by *Ralph Pemberton, M. S., M. D., Physician to the Presbyterian Hospital, Philadelphia; Associate Professor of Medicine in the Graduate Medical School of the University of Pennsylvania, etc.* Lea & Febiger, Philadelphia, 1929. Price, \$5.

This splendid monograph on arthritis and rheumatoid conditions represents the observations the author and his associates have made over a period of 15 years.

Although the profession, in general, has been somewhat indifferent in the study of these conditions, and rather cynical in regard to treatment, the author expresses the hope that this "presentation of a broad 'physiological' concept of the disease may arouse further interest in it by opening up some fields of useful therapy not widely appreciated."

For all those who have occasion to treat these conditions or who are interested in them this monograph is highly commended.

One idea which the author has carried out and for which he will be widely congratulated is his viewpoint of the rheumatoid problem. In this connection he states in his preface that he is "of the firm opinion that no single or fixed viewpoint can encompass the

rheumatoid problem which, despite the fine achievements of the doctrine of focal infection, is not a disease of the specialist in any branch of surgery. Every effort has been made, therefore, to avoid undue emphasis upon any one phase of treatment, since it is believed that only wide-angled vision can attain to anything more than sporadic results in any large group of cases."

**SYNOPSIS OF THE PRACTICE OF PREVENTIVE MEDICINE AS APPLIED IN THE BASIC MEDICAL SCIENCES AND CLINICAL INSTRUCTION AT THE HARVARD MEDICAL SCHOOL.** Edited by *Dr. Shields Warren*. Harvard University Press, Cambridge, Mass., 1929.

The faculty of the Harvard Medical School adopted in 1925 the policy of infiltrating the curriculum with preventive medicine, so that the student was practically unconsciously absorbing the ideas of preventive medicine along with other matters to which he was devoting his attention. This volume was not conceived as a text or reference book, but merely as a depository for such points as seemed of possible value in emphasizing, in connection with the present curriculum of the Harvard Medical School, the importance of preventive medicine for the practitioner. Under the heading of each course in the medical curriculum those preventive measures are discussed which naturally are bound up with the proper exposition of the subject. While this is the first time such ideas have been systematically put together, the same principles have been for many years incorporated into courses of instruction in most medical schools. To have all this material assembled in one volume, with blank alternate pages for comments as to desirable additions or subtractions as well as criticisms, is an achievement for which credit belongs to the faculty of Harvard Medical School.

**OTOLOGIC SURGERY**, by *Samuel J. Kcpetsky, M. D., F. A. C. S., Professor of Otology, Polyclinic Medical School and Hospital, New York; Director, Dept. of Otolaryngology, Beth Israel Hospital, New York, etc.* Second edition, Paul B. Hoeber, New York, 1929. Price, \$8.

Here is a book that supplies precisely and adequately all that can be desired by the otologist or by those who must either frequently or occasionally perform otologic operations.

The merits of the book are as numerous as its pages, for the author has displayed an unexcelled ability both in his literary presentation and in his otologic skill and judgment.

Every phase of each problem is thoroughly and expertly considered, although the pathology is stressed throughout.

In the choice of operative procedures the author has not taxed the time and patience of the reader by advocating or describing measures other than those of proven value established by practical experience.

The division into chapters is as follows :

Diseases of the Middle Ear; Operations on the External Auditory Canal; Incision of the Membrana Tympani (Paracentesis); Operations of the Middle Ear through the External Auditory Meatus; The Simple Mastoid Operation; The Radical Mastoid Operation; The Surgery of the Labyrinth; Otogenous Systematic Infections, Including Sinus Thrombosis; The Surgery of the Meninges; The Surgery of Otitic Brain Abscess; Laboratory Aids to Otological Diagnosis; Cases Illustrating Points in the Text.

The inclusion of a chapter on laboratory aids is a wise and helpful one.

Lastly, the author is to be congratulated for grouping his case histories into a single and final chapter, thus sparing the reader much effort and confusion. The reader can, by such an arrangement, either avoid the histories or easily find those he wishes to read.

*THE AFTER-TREATMENT OF OPERATIONS*, by P. Lockhart-Mummery, F. R. C. S. Eng., M. A., M. B., B. C. Cantab.; Senior Surgeon, St. Mark's Hospital for Cancer, Fistula, and other Diseases of the Rectum; Consulting Surgeon, The Queen's Hospital for Children, London; and Honorary Surgeon to King Edward VIII's Hospital for Officers. Fifth edition. William Wood & Co., New York, 1929. Price \$3.25.

The very fact that this book has entered its fifth edition serves as an indorsement of its value. The author does not enter into a discussion of the various methods of postoperative care, but, having selected that method and those principles which presumably have served him best, presents them carefully and concisely. The book is, as its title states, a manual to which one may turn for easily accessible information, unconcealed by discursive arguments pro and con. The first half of the book is devoted to the general topics of postoperative care such as posture, pain, thirst, the wound, hemorrhage, surgical shock, postanesthetic complications, infections of the urinary tract, thrombosis and embolism, and postoperative rashes. Of these the chapter on surgical shock is especially to be recommended as a clear and concise presentation of the problems presented and methods to be followed in treating this condition. The latter half of the book deals with the postoperative care following operations on the various anatomical regions of the body, head, neck, thorax abdomen and contents, genito-urinary tract, bones and joints, and amputations. Of these there are three chapters devoted to the abdominal contents, necessarily the longest and stressed the most. This book can be recommended as a source of easily obtained information on the treatment of all the commonest postoperative complications.

**SURGICAL DISEASES OF THE THYROID GLAND**, by *E. M. Eberts, M. D., Surgeon to the Montreal General Hospital; Associate Professor of Surgery, McGill University* with the assistance of *R. R. Fitzgerald, M. D., and Philip G. Silver, M. D.* Lea & Febiger, Philadelphia, 1929. Price, \$3.50.

This is an excellent short treatise on surgical diseases of the thyroid and their treatment. It presents a concise and thorough summary of the best thought on this complex and disputed subject. The author's wide reading and considerable clinical experience enable him to set forth an authoritative piece of work.

The first four chapters of Part I are devoted to the embryology of the thyroid gland, the anatomy and histology, the physiology, and the pathological physiology. Chapter V is confined to pathology, gross and microscopic. In the 25 pages of this chapter the reader will find one of the best short discussions of the pathology of the thyroid gland published to date. This complex subject is dealt with by the author from the basis of his personal experience in the goiter clinic of the Montreal General Hospital. The classification given by the author is considered along with the classifications of other authors

Part II is devoted to the clinical consideration of diseases of the thyroid. Students of these diseases who have often been struck by the conflicting views of various authors writing in current medical journals will find here a coherent and definite conception of thyroid disease as well as methods of treatment evolved from the author's experience and wide reading. His discussion of juvenile or adolescent goiter and its treatment, and the chapter on Graves's disease, appeared to this reviewer as of peculiar value to the physician having to care for these conditions. The author believes in early operation for exophthalmic goiter, since only by this may permanent myocardial changes be permanently postponed.

Iodine thyrotoxicosis is given a separate chapter.

Iodine medication in Graves's disease and adenomatous goiter is ably described. In the chapter devoted to nontoxic adenoma the author concludes that large doses of iodine may incite persistent hyperactivity in an adenomatous growth. He believes that nontoxic adenomata should be removed. Chapter VII is devoted to the differentiation of Graves's disease and toxic adenoma.

The comments on surgical technic are not extensive and imply a knowledge of this type of surgery on the part of the reader. They are, however, illuminating and to the point.

In a comprehensive description of inflammations of the thyroid gland the author stresses the importance of the differentiation of simple thyroiditis and strumitis from other thyroid affections and discusses the cause of the former.

Malignant disease is the last subject considered. Operation at the earliest possible time is the only hope held forth by the author.

The book is well illustrated, the print and binding are good, the differential diagnostic points are well set forth, and the comments on treatment are concise but conservative and based on personal experience in the management of cases. The author and his collaborators have produced a book worthy of praise and one which will prove of value.

An extensive bibliography is appended after each chapter.

**PRACTICAL LOCAL ANESTHESIA AND ITS SURGICAL TECHNIC**, by *Robert Emmett Farr, M. D., F. A. C. S., Minneapolis, Minnesota*. Second edition. *Lea & Febiger, Philadelphia, 1929*. Price, \$9.

In this second edition of Doctor Farr's book on local anesthesia the author presents a work of decided value to anyone engaged in the practice of general surgery. Thoroughly imbued with the value of infiltration anesthesia over that of regional anesthesia, in the hands of the average surgeon, the author, to the mind of this reviewer, uses valuable space discussing their relative importance which could be better employed in presenting more of his excellent technic. A chapter given over to consideration of matters pertaining to local anesthesia replaces in this edition the one discussing the demerits of general anesthesia in the first.

The author is still set against spinal anesthesia and dismisses this highly valuable method as too dangerous to patients in the hands of the average surgeon while he is becoming proficient in its use. In this Doctor Farr will not find agreement with a host of the younger surgeons who are also enthusiastic advocates of infiltration and regional anesthesia.

However strongly one may feel that general anesthesia will never be replaced by infiltration anesthesia, the author's list of cases, his description of his technic in such major operations as cholecystectomy, gastroenterostomy, amputation of the thigh, abdominal Caesarean section under infiltration anesthesia, with case reports, makes one realize that in the hands of the expert such operations are feasible.

The author emphasizes throughout the book the necessity of careful consideration of the psyche of the patient submitting to an operation under local anesthesia. He lays stress on arranging for the comfort of the patient on the operation table, on sharp dissection, on finger touch, and teamwork.

There are many quotations from Braun and other pioneers in local anesthesia.



The book is well printed and bound. The illustrations are very good.

This book is a valuable addition to the working tools of the general surgeon.

*POLIOMYELITIS*, by *W. Russell MacAusland, M. D., Surgeon in Chief, Orthopedic Department, Carney Hospital, Boston, Massachusetts.* Lea & Febiger, Philadelphia, 1929.

While the naval medical officer rarely has occasion to diagnose or treat a case of poliomyelitis and while poliomyelitis has not appeared in epidemic form during the last 10 years, the frequency of sporadic cases indicates the possibility of another outbreak, and all physicians are or should be aware of the importance of the disease.

The profession will welcome a book on poliomyelitis written by such an outstanding authority as Doctor MacAusland.

Much knowledge has been accumulated on the subject since the last epidemic. Many advances have been made in our understanding of the nature of the disease and much progress has been made in the methods of treatment. The author has selected for discussion and description the methods which are now recognized as having definite value.

In less than 400 pages he has also given an excellent review of an exhaustive literature concerning the epidemiology, etiology, pathology, symptomatology, and diagnosis.

The value of the book is considerably increased by many excellent illustrations.

*A MANUAL OF PROCTOLOGY*, by *T. Chittenden Hill, Ph. B., M. D., F. A. C. S., Instructor in Proctology, Harvard Graduate School of Medicine; Surgeon to Rectal Department, Boston Dispensary; Ex-President American Proctologic Society.* Third edition. Lea & Febiger, Philadelphia, 1929. Price, \$3.50.

Naval surgeons who may be called upon to treat rectal disorders will welcome the third edition of Doctor Hill's splendid little book. In some 250 pages the author has neatly covered the entire subject.

Much information of value will be found on the subjects of examination and diagnosis, catarrhal diseases of the rectum and colon, ulceration of the anus and rectum, ulcerative colitis, anal fissure, rectal abscesses, fistula, stricture, hemorrhoids, prolapse, and pruritus ani.

The last chapter, that on cancer of the rectum, has been ably written by Dr. E. Parker Hayden. This includes an excellent discussion of the pathology and diagnosis of rectal cancer and all the latest advances in operative treatment.

**THE TREATMENT OF VARICOSE VEINS OF THE LOWER EXTREMITIES BY INJECTIONS,** by *T. Henry Treves-Barber, M. D., Sc.* William Wood & Co., New York. 1929. Price, \$2.25.

This is a helpful and handy little book in which one can find all the practical points needed by those who undertake the treatment of varicose veins.

It contains only slightly more than a hundred pages and can be digested in a short time.

The author speaks highly of the injection method of treatment which has been so welcomed during recent years and which has recently occupied such a prominent place in the literature.

The object of the book is to "draw a clear distinction between those cases which are suitable and those unsuitable for treatment, and to lay down, from the author's wide experience, the technique of the operation and the choice of remedy."

**HEMORRHOIDS, THE INJECTION TREATMENT AND PRURITUS ANI,** by *Laurence Goldbacher, M. D., Philadelphia.* F. A. Davis Co., Philadelphia, 1930. Price \$3.50.

This is a valuable little book of some 200 pages. It could have been presented perhaps better in a hundred pages by omitting many of the case reports, using somewhat smaller type, allowing the type to cover a greater area of the pages, and, most important, in using vastly fewer words to express the same ideas. The book has all the earmarks of a rather long but quite good medical periodical article parading as a book. In fact, much of the material has previously appeared in journals.

It is divided into four parts—General Considerations; External Hemorrhoids and Treatment; Internal Hemorrhoids and the Injection Treatment; Pruritis Ani.

Helpful illustrations, 31 in number, are included.

**STONE AND CALCULOUS DISEASE OF THE URINARY ORGANS,** by *J. Swift Joly, M. D. (Dub.), F. R. C. S. (Eng.), Surgeon to St. Peter's Hospital for Stone; Consulting Urologist to St. James' Hospital, Wandsworth.* The C. V. Mosby Co., St. Louis, 1929. Price, \$16.

This reviewer, after an extensive examination of the book, is so heartily in accord with the statement of John Roberts Caulk, professor of genito-urinary surgery at Washington University, St. Louis, that Doctor Caulk's introduction to the American edition is copied here in full:

"One has only to glance at this volume to realize its magnitude. but a thorough scrutiny will add convincing evidence of its importance. Joly has presented the most comprehensive work on calculous disease that has ever appeared.

“This book of 555 pages is divided into eight chapters, each of which is devoted to a most complete consideration of its subject, and the composite represents the results of untiring energy, tremendous experience, and keen observation.

“When one considers that the only information registered to-day on this vast subject is to be found in short chapters of the current textbooks it is easy to appreciate how eager we should be to digest thoroughly the contents of this voluminous work.

“The first chapter on the history of urinary lithiasis is the most detailed and interesting that I have ever read, and it alone would highly recommend this work to the reader; but the author passes on to seven other chapters, each thoroughly describing its phase of the multitudinous ramifications of stone disease. In the description of renal calculus alone there are 172 pages devoted to its discussion.

“The theories of stone formation, its chemistry and etiology, are considered in the minutest detail and read with the charm of a novel. Emanating from the very heart of lithiasis study at St. Peter's Hospital for Stone and coming from the pen of a lucid writer and an experienced surgeon, this work crystallizes the latest ideas on lithiasis and recommends itself as an essential part of a physician's library.”

*UROLOGICAL NURSING*, by *David M. Davis, M. D.*, Assistant Professor of Urological Surgery, University of Rochester; and Urologist, Strong Memorial Hospital, 1924-1928; Associate in Urology, The Johns Hopkins University; Assistant Visiting Urologist and Dispensary Urologist, The Johns Hopkins Hospital. W. B. Saunders Co., Philadelphia, 1929.

This work was primarily written as a text for nurses and attendants, but should be interesting and helpful to the general practitioner and internist, and is considered a particularly valuable reference for the Navy Hospital Corps man.

In a volume of less than 200 pages of large type the author has succeeded in presenting a large number of helpful hints in a clear and concise style.

Its contents, beginning with a brief summarization of the anatomy, physiology, and pathology of the genito-urinary tract and ending with a list of urological procedures, should prove of practical value for quick reference.

Several chapters are devoted to the preparation and care of urological instruments, which should be suitable for teaching purposes.

The illustrations are ample and instructive, an invaluable feature in a text of this nature.

The chapters on procedures involved are a combination of simplicity and comprehensiveness and, in all, the general arrangement and treatment of the subject matter is well done and furnishes a

valuable amount of information which will aid the Hospital Corps man, nurse, or attendant in the care of urological cases.

As an elementary text, for which there is an unquestioned need, it fulfills its function admirably.

A PRACTICAL TREATISE ON DISORDERS OF THE SEXUAL FUNCTION IN THE MALE AND FEMALE, by *Max Huhner, M. D., Chief of Clinic, Genitourinary Department, Mount Sinai Hospital Dispensary, New York City; Formerly Attending Genitourinary Surgeon, Bellevue Hospital, Out-Patient Department and Assistant Gynecologist, Mount Sinai Hospital Dispensary, New York City, etc.* Third edition. F. A. Davis Co., Philadelphia, 1929. Price, \$3.

This latest (third) edition of Doctor Huhner's book is especially welcome at this time. The time may come when books on this subject will be as numerous as those on other medical subjects. Certainly that time still seems rather distant. The great trouble with books on most medical subjects is that there is no very great or good reason for their existence—they contain little of importance that has not already been equally well treated by many other equally good writers. This state of affairs adds much confusion and expense and brings no small amount of irritation to medical readers.

Now, this book is very decidedly an exception. It has few, if any, rivals. Just why this class of disorders, so extremely common and so exceedingly distressing, even tragic, should be so universally side-stepped by able workers and writers is a matter somewhat difficult to explain. If the writers are few, the readers are, nevertheless, many, and their cordial acceptance of this book, which has already undergone numerous reprintings, is easily understood.

The work, perhaps unfortunately, takes one into the fields of both neurology and urology. No one can treat these troubles with confidence or competence unless he is well versed in both specialties. This fact may explain in part the reason for the paucity of books on the subject.

To treat some of these conditions in the male one must be familiar with the use of the posterior endoscope, he must know the art of proper massage of the prostate, the technic of silver nitrate applications; he must recognize that a slight congestion about the verumontanum may produce profound symptoms, while certain "gross pathological lesions, such as polypi or cysts, are apparently borne without protest, either by the genitourinary apparatus or by the general nervous system." In acquiring such knowledge the use of this book will be eminently helpful. Here, also, one will find much information of a practical nature that the author has culled from the writings of such neurological and psychiatric workers as Freud, Krafft-Ebing, Havelock Ellis, Hammond, and Herz.

The subjects discussed in a most readable and illuminating manner include masturbation, impotence, pollutions, priapism, clitorism, clitoris crises, satyriasis, nymphomania, frigidity, vaginismus, dyspareunia, dyspareunia in the male, absence of orgasm in the female, enuresis, withdrawal, continence, and some unusual forms of sexual neuroses.

A new chapter on dysmenorrhea has been added in this edition.

This book can claim a valued place in the libraries of general practitioners, urologists, and psychiatrists.

**GENERATIONS OF ADAM**, by *Abraham L. Wolbarst, M. D.* Newlands Press, New York, 1930.

This treatise on psychosexual problems deals largely with the sociological aspects of the matter.

Doctor Wolbarst is eminently well qualified to write on this subject and here presents a philosophy that not only makes interesting reading but leads one into some serious thinking on the subject.

A note that runs through all the pages of the book, and one which the reader can not possibly fail to perceive is the very complete and real sincerity of the author. He has dealt with the subject in a manner and spirit that are startling in their perfect and courageous frankness.

His views may be in a large measure iconoclastic but they are based on sound physiology. The laws of physiology are inexorable—no man-made social laws; no conventions, traditions or religious tenets can ever influence them, however desirable or convenient we might believe certain changes to be. If there is any conforming to be done, society and not physiology will have to do it.

With physiology remaining the same as it always was, and with the violent changes the march of civilization has brought about in the economic and other structures of modern society, there has been a consequent and very great need for a code of social relationships which will fit into the new order. Such a code, at least in any openly accepted or generally approved form, has not yet arrived. Its absence has thus far left a wake of divorce and like human tragedies unparalleled in history.

Doctor Wolbarst offers some solutions and remedies. He looks at the picture from the point of view of one who has spent long years of serious and intimate contact with the tragic problems that come to him. Like many others who have been in a position to see these things intensely and at close range, he has come to look upon a world of poor mortal frames with more human sympathy, understanding and tolerance. The more intelligently human weakness and suffering are envisaged, the more aloofness and intolerance are replaced by compassion.

Finally, the author is to be commended for having presented the story in exactly the form and style that are best suited to those who need it and will want to read it.

**CLINICAL OBSTETRICS** by *Paul T. Harper, Ph. B., M. D., Sc. D., F. A. C. S., Fellow of the American Association of Obstetricians, Gynecologists, and Abdominal Surgeons, and of the New York Obstetrical Society; Clinical Professor of Obstetrics, Albany Medical College; Regional Consultant in Obstetrics, New York State Department of Health.* F. A. Davis Co., Philadelphia, 1930. Price, \$8.

The book is a story of individual reaction to obstetrical problems as they have presented themselves. In its telling, the author states, he has placed principles involved over and above procedures that might be carried out. To make the text clear, diagrams with appropriate legends have been freely introduced. There is an unfortunate tendency to verbosity and involved diction. The scope and depth of the subject is limited, since the author presumes that the reader has a knowledge of textbooks, works of reference, and current literature.

**AIDS TO DERMATOLOGY AND VENEREAL DISEASE** by *Robert M. B. MacKenna, M. A., M. B., B. Ch. Camb., M. R. C. P. Lond., M. R. C. S. Eng., Hon. Asst. Dermatologist, Liverpool Cancer and Skin Hospital, Medical Officer in Charge of Male V. D. Department, Stanley Hospital, Liverpool.* William Wood & Co., New York, 1929. Price, \$1.50.

This pocket-size book of 200 pages is one of the Student's Aids Series. It contains adequate material to enable students preparing for final examinations to write learnedly of the subject. Its value in actual practice is doubtful because the book necessarily is limited in scope.

**PRINCIPLES OF PHARMACY**, by *Henry V. Arny, Ph. M., Ph. D., F. C. S., Professor of Chemistry in the College of Pharmacy of Columbia University; Sometime Dean and Professor of Pharmacy in the School of Pharmacy of Western Reserve University; Vice Chairman of the Committee of Revision of the United States Pharmacopoeia, Tenth Revision; Member of the Committee of Revision of the National Formulary, Fifth Edition.* Third edition. W. B. Saunders Co., Philadelphia, 1927. Price \$8.

The third edition of Arny's Pharmacy was made necessary by the appearance of the tenth revision of the United States Pharmacopoeia and of the fifth edition of the National Formulary.

This edition contains the new data of the United States Pharmacopoeia and National Formulary and includes all the essential recent advances in chemistry, medicine, and pharmacy that are of importance to the pharmacist.

The author has made a very thorough revision of each chapter.

It is gratifying to note that the revision has not added to the size of the book. The changes have made it better rather than bigger. No other book on the subject is more authoritative or more exhaustive. In the service that it can render pharmacists it is unexcelled.

**THE PROPERTIES AND USES OF DRUGS**, by *Henry H. Rushby, Ph. M., M. D., D. Sc., Dean and Professor of Materia Medica, College of Pharmacy, Columbia University; and A. Richard Bliss, Jr., A. M., Phar. D., M. D., Dean of the School of Pharmacy; Chief of the Division of Pharmacology and Materia Medica, Colleges of Medicine and Dentistry, and School of Pharmacy, University of Tennessee (Memphis); and Charles W. Ballard, A. M., Phar. D., Ph. D., Associate Professor of Materia Medica and Director of the Microscopical Laboratory, College of Pharmacy, Columbia University.* P. Blakiston's Son & Co., Philadelphia, 1930.

This new book on pharmacy covers all the drugs in modern use as well as many useful pharmacal sundries. It is up to the minute in every respect and is somewhat more than 800 pages in length.

It is an excellent reference for physicians, although it was designed as a text and reference for student and practising pharmacists.

In addition to the drugs listed in the Pharmacopoeia and Formulary the authors have included many other articles in common use.

In the case of each drug there is adequate treatment of its origin, preparation, preservation, adulteration, standards of quality, composition, properties, and uses.

**A TEXTBOOK OF PHARMACEUTICAL ARITHMETIC**, by *Theodore J. Bradley, Phm. D., A. M., B. S., Dean of the Faculty and Professor of Chemistry in the Massachusetts College of Pharmacy.* Lea & Febiger, Philadelphia, 1929. Price, \$2.25.

In the preface the author states that pharmaceutical applications of arithmetic are comparatively simple and of limited scope, but that teachers and State boards report more failures in arithmetic than in any other subject.

Such has been the observation of this reviewer while attempting to teach corpsmen some pharmaceutical arithmetic.

This handy little book should be a distinct help to corpsmen who have difficulty in mastering these simple problems in mathematics, and it should prove a very great help to medical officers whose duties include the teaching of corpsmen. Any corpsman who works in pharmacy should be able to quickly solve the problems in this book. His ability to do so may be used as an indication of his competency as a pharmacist.

**HUMAN HELMINTHOLOGY**, by *Ernest Carroll Faust, Ph. D., Professor of Parasitology in the College of Medicine of Tulane University, New Orleans, Louisiana.* Lea & Febiger, Philadelphia, 1929. Price, \$8.

When a book of 600 pages deals with the restricted subject of human helminthology it should contain more than enough information on every point to which the clinician may wish to refer.

This book offers no disappointments in this respect. The material is well presented and amply illustrated. It leaves absolutely nothing to be desired and deserves the highest rating as a reference work.

It is highly authoritative, as the author has held a prominent place as an investigator and teacher in this field during the last two decades. It will be welcomed by the clinician, the sanitarian, and the medical zoologist.

Both theoretical and practical aspects of the subject are adequately presented.

The first few chapters, which deal with such general considerations as the scope of helminthology, parasite and host adaptations, and the foundations of helminthology, make entertaining and instructive reading even for those who have no more than a passing interest in the subject.

**MEMORANDA OF TOXICOLOGY, PARTLY BASED ON TANNER'S MEMORANDA OF POISONS**, by *Mae Trumper, B. S., A. M., Ph. D., Consulting Clinical Chemist and Toxicologist, in Charge of Psycho-Biochemistry Laboratory, Graduate School, University of Pennsylvania; Formerly Lecturer on Toxicology, Jefferson Medical College, Philadelphia, Pennsylvania.* Second edition. P. Blakiston's Son & Co., Philadelphia, 1929.

This edition, being very painstaking in its early chapters relative to definitions, modes of action, and diagnosis of poisons, tends in the chapters that follow to describe rare cases of poisoning by unusual substances, many being little heard of and hardly likely to come under the care of the average practicing physician.

Tests for the identification of some of these described poisons are included in great detail, requiring apparatus found only in well-equipped laboratories. The treatment is fully described for some substances and not mentioned for others.

Under Bites of Venomous Reptiles the author leaves the impression that serum antitoxin is used for the bite of the cobra alone, as no mention is made of the bites of other poisonous species.

This edition, as a whole, does not entirely answer the requirements of a working memorandum on toxicology for the practicing physician.



**PETTIBONE'S TEXTBOOK OF PHYSIOLOGICAL CHEMISTRY**, revised and rewritten by *J. F. McClendon, Ph. D., Professor of Physiological Chemistry, Medical School, University of Minnesota, Minneapolis.* Fourth edition. C. V. Mosby Co., St. Louis, 1929. Price, \$3.75.

This book is a manual especially adapted to class instruction of medical students. The course outlined requires a previous knowledge of general and organic chemistry. The text is arranged to cover all branches of physiological chemistry of interest to medical students and makes a good basis for the concurrent study of physiology.

The text is not sufficiently extensive for reference purposes or advanced instruction. It could be used as a review by medical officers studying for examinations for promotion or for State boards. The larger books on the subject usually seem too formidable an undertaking for such purposes.

The book is also suitable as collateral reading for laboratory technicians who too often learn to carry out these chemical procedures without an adequate background of the principles involved.

**HANDBOOK OF BACTERIOLOGY FOR NURSES**, by *Harry W. Carey, A. B., M. D., Assistant Bacteriologist, Bender Hygienic Laboratory, Albany, N. Y. (1901-1903); Pathologist to the Samaritan Hospital, Troy, N. Y., Cohoes Hospital, Cohoes, N. Y.; and Putnam Memorial Hospital, Bennington, Vermont.* Third edition. F. A. Davis Co., Philadelphia, 1930. Price, \$2.25.

There was need for this third edition in order to have the book include certain essential advances which have occurred during the 10 years that have passed since the appearance of the second edition.

In its present form the book supplies the information in bacteriology now required of nurses by the National League for Nursing and State boards of education.

The material is admirably and concisely presented, and 43 well-chosen illustrations add considerably to the value of the book. It should be very helpful in teaching bacteriology to Hospital Corps men as well as nurses.

**LABORATORY METHODS OF THE UNITED STATES ARMY**, Edited by *Charles F. Craig, M. A., M. D., Colonel, Medical Corps, United States Army.* Third edition. Lea & Febiger, Philadelphia, 1929. Price \$3.50.

This, the third edition, revised, of Medical War Manual No. 6, far surpasses the former editions. It contains four entirely new sections, and the old ones have been greatly enlarged, brought up to date, and practically rewritten.

The arrangement of the subject matter into parts is to be commended.

While the reviewer finds a few methods which he thinks important, omitted, and some details of the Kahn test not quite the last word, nevertheless it is felt that this little book contains the cream of methods used in any branch of laboratory work.

*CLINICAL MEDICINE FOR NURSES*, by *Paul H. Ringer, A. B., M. D., Formerly Chief of Medical Service of the Asheville Mission Hospital, Asheville, N. C., and on staff of Biltmore Hospital, Biltmore, N. C.* Third Edition. F. A. Davis Co., Philadelphia, 1929.

This book, taken largely from lectures given by the author to nurses, is useful for teaching purposes. The selected material, covering a number of the commoner diseases, would seem to meet the present-day needs of student nurses.

As the writer states, the bacteriology and pathology of diseases, save in a very few instances have been but sketchily traced. Chapter 11, covering briefly food and nutrition, is followed by a chapter on immunity and seven chapters concerned with important infectious diseases, their origin, mode of transmission, and method of control. The chapters on diseases of the organs of circulation, respiratory organs, the urinary tract, and blood cover the ground adequately. The closing chapter on pernicious anemia and leukemia is followed by a glossary of 250 technical terms.

The material is not too technical for the average group of student nurses, the main points dwelt upon being symptoms and their meaning and complications and their detection as far as the nurse is concerned.

Additional illustrative material would have added considerably to the book. The glossary should be most helpful in the preparation of quizzes.

The book, as a whole, seems specially suited for the purpose intended and could, no doubt, be used to advantage in many schools of nursing.

*PRACTICAL DIETETICS, DIET IN HEALTH AND DISEASE*, by *Alida Frances Pattee*. Seventeenth edition. Mount Vernon, N. Y., 1929.

The chapters on Classification and Food Values are written in words that can be readily understood, and the chapters on Food Preparations and the many recipes are very helpful in varying the monotony of the patients' trays.

Those who have read the sixteenth edition will find the new edition much more valuable, especially in the ever-increasing diets for special diseases.

The chapters on Vitamins and on Pellagra are especially valuable.

Those who are interested in "special diets" may turn to the chapter on Diabetes Mellitus and there find great help in giving patients

more variety and more tasty foods. In the chapter on Anemia, Miss **Pattee** has included many new liver recipes.

**MODERN METHODS OF TREATMENT**, by *Logan Clendening, M. D., Professor of Clinical Medicine, Lecturer on Therapeutics, Medical Department of the University of Kansas; Attending Physician, Kansas City General Hospital, Physician to St. Luke's Hospital, Kansas City, Missouri.* Third edition. C. V. Mosby Co., St. Louis, 1929. Price \$10.

The author's endeavor to outline all the methods of treatment used in internal medicine has been successful to a marked degree. The style is interesting, the facts illuminated now by historical details, now by apocryphal legend. Simple diagrams are introduced which clearly present some of the more complex actions of drugs. No effort is made to deal with all drugs; only those of practical importance to a practicing physician are considered. The author has a happy faculty of stating in a few words what is worth while and then stopping. Each subject is carefully examined against its historical background and its therapeutic value essayed critically. Theoretical and controversial matter is avoided, as is best seen in the chapter on biologic therapy and prophylaxis.

The scope of the book is rather broad, including, among other subjects: Malarial treatment of neurosyphilis, typhoid treatment of thrombo-angiitis obliterans, the value of extracts of ductless glands, climate, heliotherapy, mineral springs, and health resorts. The author deals with these subjects without bias, pointing out conditions in which improvement may be expected.

Perhaps the outstanding chapter is the one on dietetics. The part dealing with diet in disease is especially valuable; moreover, it is presented in such a way that one might describe it as dealing with applied rather than with pure dietetics. Infant feeding is discussed in detail, followed by a section on table food during the first year.

Such subjects as heat, cold, baths, packs, gymnastics, massage, electrotherapeutics, and radiotherapy have not been forgotten.

Some of the best practical material in the book will be found in the chapter on psychotherapy. Principles of as great, if not greater, importance to many a patient than all other forms of treatment combined are brought to the reader's attention.

One who has never seen agglutination when blood is matched prior to transfusion could, by glancing at the graphic representation of blood corpuscles showing both agglutination and no agglutination, safely carry out the procedure. Among other procedures described or illustrated are lumbar puncture, thoracentesis, artificial pneumothorax, dilation of esophagus, gastric lavage, duodenal drainage, paracentesis abdominis, use of sigmoidoscope in treatment, therapeutics of adhesive tape, and artificial respiration.

The second half of the book is devoted to the application of therapeutics to particular diseases. The author makes very clear what should be done (and how) in each of the infectious diseases, in diseases of allergy, and of metabolism. The different methods of treatment of diabetes mellitus are outlined, as well as the liver treatment of pernicious anemia.

That visceroptosis can be satisfactorily treated by a method which is simple and promises well is not generally recognized.

It is in the chapter on treatment of common nervous diseases that the author's understanding of humanity, his unusual good common sense, and delightful style are best displayed.

Summing up: Here is a book, up to date, conservative, practical; pervaded by a constructive and optimistic philosophy of life, and as interesting to read as a popular novel.

**AN INTRODUCTION TO THE STUDY OF THE NERVOUS SYSTEM** by *E. E. Hewer, D. Sc. (Lond.), Lecturer in Histology and Assistant Lecturer in Physiology at the London (Royal Free Hospital) School of Medicine for Women; and G. M. Sandes, M. B., B. S. (Lond.), M. R. C. S., L. R. C. P., Demonstrator in Anatomy at the London School of Medicine for Women, Surgical Registrar to the London Lock Hospital for Women and Children, etc.* The C. V. Mosby Co., St. Louis, 1929. Price, \$6.50.

This book was designed as a result of teaching experience to meet the needs of third-year medical students entering the study of the nervous system for the first time. It is highly schematic and diagrammatic; there are 104 pages of text and 55 diagrams. These diagrams aid greatly in the understanding of neural functions, and it is here that the authors show the results of their teaching experience.

It is doubtful if a thorough groundwork in neuro-anatomy and neuro-physiology, or the structure and function of the nervous system, can be successfully presented in such a simple and concise manner. For the special student in the field or for anyone who demands all the available facts from which to arrive at his own conclusions such a dogmatic presentation has no place.

However, a clear knowledge of the structure of the central nervous system and its functions, based upon an intricate organization, manifesting itself in a complex interaction and integration, as here presented, would do much to improve the general status of neurology in the profession. Within those limits it is an excellent little book.

**DISEASES OF THE NERVOUS SYSTEM, A TEXT-BOOK OF NEUROLOGY AND PSYCHIATRY,** by *Smith Ely Jelliffe, M. D., Ph. D., Formerly, Professor of Psychiatry, Fordham University, New York, and Formerly Adjunct Professor of Diseases of the Mind and Nervous System, New York Post-Graduate Medical School and Hospital; and William A. White, M. D., Superintendent of St. Elizabeths Hospital, Washington, D. C.; Professor of Nervous and Mental Diseases, Georgetown University; Professor of Nervous and Mental Diseases, George Washington University, and Lecturer on Psychiatry, U. S. Army and U. S. Naval Medical Schools.* Fifth edition. Lea & Febiger, Philadelphia, 1929. Price, \$9.50.

There is little need of bringing to the attention of the Naval Medical Corps this book of Jelliffe and White's. The book has been a standard in the Navy for many years. The book needs no praise. Its merits require no advertisement. It need only be said that a new edition has appeared.

This latest revision incorporates all the important recent researches, and special attention has been given to the more recent outlooks concerning the vegetative nervous system.

The authors have well stated an aim in which they have well succeeded: "The accent therefore in this, as in previous editions, is toward a scientific curiosity in solving riddles heretofore insoluble. We have preferred to tell the student, the practitioner, and the specialist as well, what little is definitely known, and how great is the territory still to be explored and conquered, rather than to be satisfied with a simple recital of the static, the known, and the dead past."

**THE AUTONOMIC NERVOUS SYSTEM,** by *Albert Kuntz, Ph. D., M. D., Professor of Anatomy in St. Louis University School of Medicine.* Lea & Febiger, Philadelphia, 1929. Price \$7.

This is no book for light reading or for readers who are only superficially interested in neurology.

It is an exhaustive and profound treatise on the anatomy and physiology of the autonomic nervous system.

Those who wish to acquire a wide knowledge and broad understanding of the autonomic nervous system can consult no better work.

Neurologists and clinicians in general who are willing to expend the time and effort may pore over the pages of this book and will receive high reward in the extraction of much meat. They will gain the satisfaction and the advantage brought by a knowledge of the underlying anatomical and physiological aspects of clinical problems in which the autonomic nervous system figures.

Those who lack the patience or interest for the more academic elements of the subject may skip the first 17 chapters (430 pages) and read only the last 3 chapters (70 pages). These last chapters include much of clinical import. They deal respectively with: *Vagotonia* and *sympatheticotonia* (including a lengthy critique of the conception); the clinical significance of autonomic nervous lesions; surgery of the autonomic nervous system.

In the last chapter the author has given an excellent historical summary, the surgery of the system, a critical analysis of results obtained, and a sound appraisal of the value of the various operative procedures.

**THE HEALTH OF THE MIND**, by *J. R. Rees, M. A., M. D., Deputy Director of the Travistock Square Clinic, London.* Washburn & Thomas, Cambridge, 1929.

This book of 266 pages, designed for popular consumption, is not technical and may meet the needs of the ordinary layman's reading, but for the more advanced or serious student it has no place. The author says: "It is an expression of the unoriginal personal views of one who does not feel himself bound down to any particular school of thought. Essentially, it is an effort to meet some of the needs of the ordinary man who feels that he might be more adequately informed than he is on questions concerning his mental processes and the problems of behavior which result from them."

**SURGICAL CLINICS OF NORTH AMERICA, OCTOBER, 1929.** W. B. Saunders Co., Philadelphia, 1929.

The Philadelphia number of the *Surgical Clinics of North America* for October, 1929, has many very interesting and complete articles. Attention of naval medical officers is invited to several of these articles which deal closely with their service.

"Clinics of Drs. John B. Deaver and Verne G. Burden," covering a discussion of ulcers, hernia, hematoma of rectus muscle, suppurative thyroiditis, and cholangitis, has many valuable points emphasized.

"General Surgical Clinic of Dr. W. Wayne Babcock" deals with operative decompression of aortic aneurysm by carotid-jugular anastomosis, carotid-jugular anastomosis in treatment of pulmonary tuberculosis, phrenicotomy for pulmonary tuberculosis, and muscular palsy, following treatment of malaria, by injection of sodium cacodylate and extensor paralysis of the foot following injection of alcohol for sciatica.

"Clinic of Dr. Charles F. Nassau" on treatment of gastric and duodenal ulcer.

"Clinic of Dr. T. Turner Thomas" on primary closure of the wound in compound fractures.

"A Clinical and Pathological Discussion of So-Called Subacromi-  
cal Bursitis," by Dr. John Benton Carnett and Eugene A. Case.

"Traumatic Rupture of Spleen," by Dr. Calvin M. Smyth, jr.

"Carcinoma of Prostrate," by Dr. Albert E. Booth.

"Chronic Duodenal Ulcer," by Drs. E. L. Eliason and Drury  
Hinton.

"Osteogenic Sarcoma of the Tibia, by Drs. Willis F. Mange,  
Edward J. Klopp, and Bruce L. Flemming.

"Unusual Tumors of the Soft Parts, by Drs. Astley P. C. Ashhurst  
and Edward T. Crossan.

"Middle Nasal Turbinal Abnormality Fundamentally Responsible  
for Many Common Ills Regarded Usually as of Doubtful or  
Unknown Origin, by Dr. J. Leslie Davis."

**MEDICAL CLINICS OF NORTH AMERICA, NOVEMBER, 1929.** W. B. Saunders Co.,  
Philadelphia, 1929.

This number of Medical Clinics is filled with interesting papers  
from many of the prominent clinics of New York City. A wide  
range of subjects is covered, among these being Functions of the Gall  
Bladder, Pernicious Anemia, Blood in the Urine, and the Diagnosis  
and Differential Diagnosis of Nephritis. A study of all the papers  
would be profitable to any physician.

**SURGICAL CLINICS OF NORTH AMERICA, DECEMBER, 1929.** W. B. Saunders Co.,  
Philadelphia, 1929.

The December number of the Surgical Clinics is from the Lahey  
Clinic in Boston. Two of the papers are by Dr. F. H. Lahey, the  
first on thyroid dysfunction and second on appendicitis. Eight of  
the first articles in this number are on the various phases of thyroid  
disturbance and constitute an excellent discourse upon the subject.  
Anesthesia is the subject of three papers by Doctors Sise and Wood-  
bridge, who discuss the choice of anesthesia.

The rest of the number is devoted to miscellaneous surgical sub-  
jects. The article on appendicitis is specially interesting in the dis-  
cussion of drainage in appendicitis. The last paragraph also can  
well be quoted: "One can not deal with the surgery of acute appendi-  
citis without constantly gaining respect for its ever-present possibili-  
ties of serious outcome. It is a disease never to be taken lightly, and  
one in which a surgeon may display advantageously his greatest  
degree of surgical judgment and technical skill."

In discussing the toxic effects of the Graham test Dr. H. D. Adams  
makes the comment that those conditions in which severe reactions  
are apt to occur include the following:

1. Patients subject to vasomotor instability, anaphylactic or sensi-  
tization reactions.

2. Patients with advanced cardiovascular disease.
3. Patients with hepatitis or cirrhosis.
4. Patients with signs of biliary obstruction.

The whole number is well written and contains much interesting discussion.

**A CHEMICAL DICTIONARY**, by *Ingo W. D. Hackh, Professor of Chemistry, College of Physicians and Surgeons of San Francisco, California, Author of "Chemical Reactions and their Equations."* P. Blakiston's Son & Co., Philadelphia, 1929.

This unique dictionary contains the scientific vocabulary not only of chemistry but of the borderland between physics and chemistry and other sciences. Structural formulas are fully used, numerous original diagrams and tables are included, and useful facts for which one might search in a well-equipped library for hours are alphabetically listed and easy of access. Illustrations and portraits are numerous. The volume undoubtedly represents the work of many years.

**PRACTICAL MASSAGE AND CORRECTIVE EXERCISES WITH APPLIED ANATOMY**, by *Hartviz Nissen, Late President of Posse Normal School of Gymnastics; Former Instructor of Physical Training at Johns Hopkins University and Wellesley College.* Fifth edition. F. A. Davis Co., Philadelphia, 1929. Price, \$2.50.

This is an elementary book designed as a guide for the nonmedical masseur or gymnast. Freely illustrated.



# THE DIVISION OF PREVENTIVE MEDICINE

Capt. M. A. STUART, Medical Corps, United States Navy, in charge

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NOTES ON PREVENTIVE MEDICINE FOR MEDICAL OFFICERS, UNITED STATES NAVY

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## EXPERIMENTAL TREATMENT OF FILARIASIS WITH INTRAMUSCULAR INJECTIONS OF OIL OF CHENOPODIUM

### A PRELIMINARY REPORT BY THE TECHNICAL STAFF OF THE HEALTH DEPARTMENT OF AMERICAN SAMOA

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#### PART I

##### THE NATURE OF FILARIASIS, ITS PREVENTION AND CONTROL

Filariasis is the only insect-borne disease that is endemic in American Samoa. So far as known, the disease is transmitted only by mosquitoes which have bitten human subjects carrying filarial embryos in their peripheral circulation at the time the blood meal is imbibed. Man is a definitive host of this parasite. Infected humans are a source of danger to their neighbors and to themselves when mosquito vectors are present. If the blood-sucking mosquito happens to take in a considerable number of the embryos, the insect may not survive to bite another person. The most dangerous mosquitoes are probably those which have ingested only a few of the embryos.

In the stomach of the mosquito the sheathed embryos, which presumably can not leave their egg sacs in the human host, are able to escape. They then begin their development into male and female worms. When the mosquito again bites a subject, these free embryos which are undergoing development, to become eventually adult

worms, are deposited on the skin and sometimes are injected into the skin. It has been established that the worms can make their own way through the skin in the same manner as hookworm embryos.

The epidemiological picture of filariasis is very different from that of malaria. One infected mosquito carrying malarial parasites can convey the disease with a single bite. A human being, to develop any manifestations of filariasis, must be bitten by many infected mosquitoes. Each mosquito in turn introduces one or more free embryos, which may or may not survive to become adult worms in the definitive host. Males and females eventually reach lymphatic tissue, where further migration is arrested by their increasing size. The female produces eggs which elongate and become the sheathed embryos which we find at times in the peripheral blood, ready to be ingested by a mosquito.

If the insect, acting as intermediary host, were not essential to the life cycle of the parasite, the epidemiological picture would be very different from what it is. One bite of an infected mosquito conveying a male and a female free embryo would be sufficient to start the life cycle in the human subject, and in a comparatively short time his body would be filled with ever-increasing numbers of adult worms which would cause death in a comparatively short period of time. That is not what happens. White persons who have lived among Samoans, unscrubbed, usually reside in the islands for many years before showing any filarial embryos in their blood or developing any symptoms of filariasis. Among the Samoans, apparently, the percentage of those having filarial embryos in the blood gradually increases from age group to age group. Many, perhaps most, of the young adult Samoans who have had filariae in their bodies for several years have not yet developed clinical manifestations of the infection. Some of those who are infected will no doubt go through life without symptoms. By and large, those Samoans who are frequently exposed to mosquitoes are inoculated with free embryos from time to time, and so gradually the numbers of adult worms increase within their bodies.

There are probably a number of factors also which tend to limit the numbers of adult worms, apart from the number of reinoculations. The first of these is the matter of the life span of the filarial worm. Definite evidence on this point is lacking, but from time to time, as the years pass, adult worms must reach the limit of their life span and die naturally. Observation of cases seems to indicate that a number of conditions—such as toxemias from acute intercurrent bacterial infections, a day of hard work involving the elaboration of fatigue poisons in muscles, and chilling of the body, as by wearing clothing wet by rain, or by working or fishing in the ocean—not infrequently seem to bring about the death of one or more adult

worms, with attending symptoms which the natives call "pueia" or "mu mu."

Otherwise the clinical characteristics of the disease suggest that the tissues of the body do not resent the presence of the worms so long as they remain alive. At least the immunological forces of the host do not resolve themselves into the production of any immune substance capable of destroying the parasites. The living worms cause, to a variable degree, a sufficient irritation of tissue cells in lymphatic vessels and glands to produce hyperplasia, which results eventually in obstruction of the affected lymph channels. This might be pictured as analogous to the irritation caused by tubercle bacilli which have invaded lung tissue, and which cause the collection of epitheloid cells, and later the formation of a tubercle with giant cells, which in the course of time undergoes fibrotic or other changes. It seems probable, however, that elaboration of toxin is not associated with the presence of living filarial worms as seems to be the case with tubercle bacilli. Any friction or other form of traumatism of tissue cells leads to hyperplasia, and it is not necessary to postulate toxin production to appreciate the damage caused by living filaria. The filarial worms, here and there, probably cause some little interference mechanically by the blocking of small lymphatic ducts. Occasionally such disturbance of the flow of lymph may favor the multiplication of bacteria which have gained entrance to the body adventitiously. Our study of a considerable number of cases seems to indicate, however, that bacterial infections are by no means of common occurrence. Probably when secondary bacterial infection does occur it is almost always associated with the death of a worm and resulting damage to the tissues from toxin then formed.

In comparison with the total number of attacks of filarial fever, accompanied by local signs of inflammation, suppuration is very infrequent. Such attacks are called by the natives "pueia" with "mu mu." An attack consists of heat, pain, and swelling in a limb or breast or in an enlarged gland. Introducing the attack, or concurrently with it, the patient has chills, fever, backache, pain in the epigastrium, and numbness in the feet and legs or elsewhere in the body. In many cases such attacks occur in filarial subjects as often as two or three times a month. They seem not due in any way to bacterial infection. The first assumption that comes to mind is that those symptoms are due to a protein reaction arising from the action of antibodies formed by the tissues of the host to deal with the antigen consisting of the dead foreign protein of the worm. Probably Sir Patrick Manson was right in assuming, as he did many years ago, that the death of parent parasites is generally associated with attacks of acute lymphangitis.

Manson showed that the adult worms may become cretified and that large numbers may be found in this condition in the glands and lymphatic trunks, where, alive, they give rise to giant cell formation and fibrotic changes. Manson believed that these fibrotic changes are the real cause of obstruction, but that lymph stasis alone would not produce elephantiasis, a point which would appear to be proved by experimental ligature of lymphatic trunks. However, if inflammation occurs, as it may from any slight injury or infection, or, as we believe, from a protein reaction incidental to the disposal of a dead worm, in an area of lymphatic congestion resulting from obstruction, elephantiasis may supervene. As Manson said, unless the lymphatics of an inflamed area are patent the products of inflammation are not completely absorbed.

Manson's statement of the sequence of events in the production of elephantiasis are of particular interest. He listed them as follows:

Parent female filaria in the lymphatic system of the affected part; obstructive fibrotic changes in the glands or lymphatic trunks, or injury of the filaria leading to premature expulsion of ova; impermeability of lymphatic glands supervening on either cause of obstruction; stasis of lymph; lymphangitis due to bacterial invasion through wounds of the skin, or to toxins derived from the parent worm itself, or to the products of disintegration of microfilaria in the congested area; imperfect absorption of the products of inflammation; recurring attacks of inflammation from similar causes, with gradual, intermittently progressive, inflammatory hypertrophy of the part.

This appears to be an essentially correct explanation of what happens. Study of our cases merely suggests that the usual cause of inflammation in the obstructed and congested area is a split protein toxic product, of the character first described by Vaughn, formed by the action of an antibody ferment produced by the blood or tissues to act upon the antigenic protein of a dead worm. Subsequently, in some cases secondary bacterial invasion occurs. This would seem to be a chance happening. Certification of worms in some cases and the clinical histories in many cases suggest that individuals differ greatly in their immunological reactions to the antigenic worm protein and in the intensity of resulting inflammation. These differences in proteolytic activity, as well as in differences in the degrees of obstructive and fibrotic changes, probably account for the many differences in the clinical characteristics of the disease and the slowness or rapidity with which elephantiasis develops. Many of our patients who exhibit no definite signs of elephantiasis have been subjected to frequent attacks of filarial fever for several years. On the other hand, we have some cases of elephantiasis which have apparently developed without conspicuous attacks of local inflammation. In some cases, however, marked elephantiasis appears to have developed quite rapidly.

Cases differ greatly, no doubt, with respect to such factors as the total number of worms in the body and the frequency of super-inoculations. Then, the factors which determine the distribution or localization of the worms in different parts of the body are probably so numerous as to fall within the realm of chance. In general, the legs are probably more frequently bitten by mosquitoes than the upper parts of the body.

After elephantiasis has developed the peripheral blood in many cases contains no filarial embryos. In our series of cases, 50 per cent of the women and 51 per cent of the men with elephantiasis have given blood smears containing filarial embryos. Of patients who have no elephantiasis, 62 per cent of the women and 64 per cent of the men have given positive blood smears. Of course, a question might be raised regarding criteria of diagnosis in the latter group. There is little doubt, however, from the medical histories and physical findings, that all have filarial disease. Repeated examinations were made in some cases over a period of several months before the microfilaria were found. The clinical features of filariasis are considered in more detail later in connection with the results of an experimental method of treatment carried on during the past year.

*Distribution in American Samoa—cases notified in 1928*

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Eastern.....	0	5	5	3	2	5	2	5	4	5	8	7	51
Central.....	1	4	5	7	9	11	11	7	4	18	12	7	96
Western.....	10	15	7	7	25	17	19	32	17	30	35	33	247
Ta'u.....	9	4	12	11	14	12	2	7	18	16	16	34	155
Ofu-Olosega.....	3	6	9	5	20	9	9	10	11	17	12	9	120
American Samoa.....	23	34	38	33	70	54	43	61	54	86	83	90	669

Instructions for the reporting of notifiable diseases, of which filariasis is one, require that every case seen during the month covered by each report will be recorded as a new case unless the case has been reported in some previous month. Filarial infection is, of course, a chronic disease, and every month some cases of long standing are seen for the first time. The figures shown above do not give any idea as to the actual number of Samoans who are infected with filarial worms at the present time. If the present system of recording morbidity is continued and individual health records are kept, as they should be, by card system, in each district, in the course of time the morbidity statistics will quite accurately reveal the trend of filariasis incidence. The mortality statistics will also serve as an index of prevalence as well as damage.

We plan to begin at once the task of making out a card, which will serve as a health record abstract, for every resident of American Samoa—man, woman, and child. Among other uses, these cards will

serve the purpose of an accurate census. Regarding filariasis, the initial schedule of information will cover the questions, "Has this person elephantiasis?" and if not, "Has this person any other evidence of filariasis as would be indicated by the native words 'peuia' and 'mu mu'?" Gradually more and more of the cards will come to contain entries for examinations of the blood also.

We have no statistical records to show whether filariasis is more or less common among natives of American Samoa than it was many years ago. Probably the incidence is less than it was. Intelligent Samoans and white men who have lived in these islands for many years think that it is less. We do not see the very large elephantoid scrotums, said to have been common 20 to 30 years ago, but surgery has changed that picture. We do see enormous legs on many older persons and occasionally on subjects less than 20 years old. We know too that many young Samoans, male and female, and some very old persons have filarial embryos in the peripheral blood frequently or constantly, and without symptoms. During the spring of 1928 a survey of the bloods of members of the native Fita-fita guard was made. Seventy-eight fitas were examined. Positive blood smears were obtained from 44 per cent. Later a number of naval station employees, nurse maids, Samoan nurses, and other young adults were added. In the entire group, 48 per cent were found to be carriers of filaria.

Recently a blood survey has been made of 465 pupils in the Poyer School, government graded school, and in the school conducted by the Catholic Brothers. The results were as follows:

Ages	Number in group	Number positive for filarial embryos (micro-filaria)	Per cent positive
5 to 9.....	146	6	4.11
10 to 14.....	191	8	4.18
15 to 19.....	112	19	16.96
20 to 25.....	16	2	12.50
All ages.....	465	35	7.52

The youngest child found positive was a boy, age 6, a pupil at the Brothers' School. In the age group 5 to 9 years, Poyer School pupils showed 4.58 per cent positive, and Brothers' pupils 2.70 per cent. Of the children 10 to 14, Poyer pupils showed 5.40 per cent positive, and Brothers' pupils none positive. Of those 15 to 19 years old, Poyer pupils showed 17.73 per cent positive, and Brothers' pupils 16.66 per cent. The children attending the Brothers' School

pay for their tuition. They represent the Samoan aristocracy, so to speak, or at least their families have some cash. Better protection against mosquitoes might be expected. Most of them live in the vicinity of the naval station.

*Disability caused by filariasis.*—We have no means at present for calculating the total disability or damage in terms of loss of working time caused by this disease, but we know it must be very great. Some patients with elephantiasis reach a stage before the age of 50 where they are almost completely disabled. Every year a number of males with this sort of disability must be granted certificates of exemption from the payment of taxes. Many persons in the earlier stages of elephantiasis are incapable of productive labor, because vigorous exercise of their muscles brings on an attack of filarial fever which disables them for two to five days or longer. Many filariasis subjects who have not as yet developed elephantiasis are likewise prone to such attacks.

Analysis of the medical histories of 330 patients, men and women, varying in age from about 18 to about 60 years, gives a good idea of the loss of time from useful employment suffered by victims of the disease. At the first consultation each patient was questioned to determine the number of days of actual disablement during the year previous to beginning of experimental treatment. The figures obtained show that 105 women patients were disabled by attacks of filarial fever, threatened filarial abscesses, and suppuration—"pueia," "mu mu," etc.—for an average of 33 days in the course of the year. The figures for 225 men, whose medical histories are available, show an average of 39.7 days of disablement during the previous year. The figures relate only to disablement resulting from the acute manifestations of the disease. There is besides, in elephantiasis cases, the interference with working capacity caused by the enlargement of limbs. Four of the women and 46 of the men reported no disablement or loss of time from the disease during the entire year. On the other hand, 8 women and 27 of the men were disabled by acute manifestations for more than 90 days. These patients came themselves or were helped by friends to attend an out-patient clinic. They were not cases which were hospitalized, or actually bedridden. None of the women and only four of the men were constantly disabled. There are bedridden patients in most of the villages who could not reach this clinic, and the data, of course, do not include such cases. The figures in more detail are as follows:

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Number of days of disablement caused by acute manifestations of filariasis during the year previous to beginning treatment	Men	Women	Total
1 to 4.....	8	12	20
5 to 9.....	11	8	19
10 to 19.....	31	22	53
20 to 29.....	38	18	56
30 to 39.....	17	8	25
40 to 49.....	25	14	39
50 to 59.....	6	3	9
60 to 69.....	0	0	0
70 to 79.....	15	8	23
80 to 89.....	1	0	1
90 to 99.....	5	4	9
100 to 109.....	10	1	11
110 to 119.....	0	2	2
140 to 149.....	3	1	4
150 to 159.....	2	0	2
160 to 169.....	1	0	1
170 to 179.....	1	0	1

Five of the male patients appeared to have been disabled for more than 180 days in the course of the year—180, 250, 252, 300, and 365 days, respectively. The aggregate number of sick days experienced by these 330 patients, as a result of acute manifestations of filariasis, was 12,417.

We have no definite information concerning the comparative loss of labor resulting from filariasis among other Polynesian peoples or among Melanesians in the South Pacific Island groups. Lambert states that the labor loss which may occur through filariasis is well illustrated by a stay he made on Metavan plantations on Malekula in the New Hebrides. During a period of one month, among a labor force of 69 recruited in the north New Hebrides, 6 people lost 34 labor days from filarial infections. The parts of the body affected were as follows: Legs, 3; axilla and breast, 1; the axilla and arm, 1; and the knee joint, 1.

*Deaths.*—Filariasis has been recorded as the primary cause of death in all cases of that disease when the medical history and manifestations of the last illness indicated that the filarial infection really was the underlying cause. In certain other cases, where some other disease or condition was regarded as primarily the cause of death, filariasis has been recorded as the secondary or contributory cause. In other cases, where, presumably, long-standing filarial infection played a part in shortening the individual's life, it has not been practicable to estimate the effects of the filarial infection. For example, a male, 56 years old, while talking to friends, apparently in a fair state of health, suddenly developed dyspnea, became cyanotic, and died in a few minutes. The immediate cause of death was occlusion of the coronary artery or acute dilatation of the heart. He was very fat and had had symptoms and signs of heart disease for several years. He was also a filarial subject and had been an invalid for several months before his death. He developed a large filarial abscess in a muscle in the lumbar region about a week before death.



The primary cause of death was recorded as arteriosclerosis and the secondary as obstruction of the coronary artery. Cases have also presented themselves for study in which septicemia of unknown origin was the immediate cause of death, while filariasis may have been the underlying cause, but could not be so recorded in the absence of a definite history of active filarial infection.

Filariasis was recorded as the primary cause of 8 deaths in 1928, making the death rate 89 per 100,000. By districts the death rates were: Eastern district, Tutuila, 80; central district, Tutuila, 97; western district, Tutuila, 81; Ofu-Olosega district, 113; and Tau district, 81 per 100,000.

The following table shows the sex, age, and place of residence of descendants as well as the secondary cause of death in these eight cases:

Sex	Age (years)	District	Primary cause of death	Secondary cause	Deaths
Male.....	49	Tau.....	Filariasis.....	Chronic multiple arthritis and myocarditis.....	1
Do.....	54	Western.....	do.....	Pyemia.....	1
Do.....	55	Central.....	do.....	General septicemia.....	1
Female.....	59	Western.....	do.....	Filarial fever.....	1
Male.....	60	Central.....	do.....	Filarial abscess, abdominal wall; septicemia.....	1
Do.....	64	Ofu.....	do.....	Septicemia and toxic myocarditis.....	1
Do.....	65	Eastern.....	do.....	Filarial abscess; septicemia.....	1
Female.....	86	Central.....	do.....	Septicopyemia.....	1

*Prevention and control.*—The problem of the prevention and control of filariasis is one of attempting to limit and reduce the numbers of inoculations of human hosts by the insect vectors. We should also try to reduce the numbers of mosquitoes infected by human hosts. The problem is not hopeless even under existing conditions. Theoretically, it should be easier to control filariasis than malaria. It is not necessary to prevent the breeding of all mosquitoes which may act as vectors of malaria or to destroy all *Aedes aegypti* mosquitoes in an infected locality to eradicate yellow fever. A marked reduction in the numbers of mosquitoes in flight may serve, practically, to prevent further infections. The life of a mosquito is precarious, due to the action of the elements and to the activities of the natural enemies of that insect. There are many chances that a given mosquito will never have a blood meal from a human being, and if it does, there are many chances that it will not survive to bite another. A 10 per cent reduction in the total numbers of mosquito vectors in a given locality will lead to more than 10 per cent reduction in the new infection or reinfection rate.

In American Samoa there are undoubtedly many places, principally in small collections of water in trees on mountain sides, where mosquitoes can breed practically beyond reach. An attempt to con-

trol breeding in such places would be enormously expensive. There is no reason to worry much about that. If all villages would undertake and carry on constantly simple procedures in and around the village for a few hundred yards, very great reductions in the numbers of mosquitoes in flight would be secured, and in a comparatively short time such efforts would have a decided effect on the incidence of filariasis. Such work would include careful policing to secure proper disposal of empty tin cans, coconut shells, and all other articles which may hold water. Adequate ditches should be dug and kept open to dispose of standing water in the comparatively few swampy areas. Grass and weeds should be kept low for a reasonable distance around each village, and attention should be paid to trees in these areas. All vessels, tanks, barrels, or other containers used for storing water should be emptied regularly once a week or be adequately protected by metal screening. Fortunately, the soil is very porous in these islands and the surface dries quickly after rainfall. Little or no breeding of mosquitoes can take place on hillsides or mountain sides unless it be in trees. The trade winds blow many mosquitoes away, but there are periods of calm.

Laws and sanitary regulations looking to the control of mosquito breeding were adopted several years ago, and sanitary conditions in this respect are no doubt better than they were. It is our estimate of the situation now that further progress depends largely upon a general understanding among the natives of the nature of filariasis and the measures necessary for its control. Public health education and law enforcement must go hand in hand. During the past year the establishment of clinics for the treatment of filariasis and the demonstration of filarial embryos in the blood of a high percentage of those attending the clinics has unquestionably done a great deal to enlighten large numbers of natives. The educational work should become more and more effective as time passes. When the natives do come to realize fully that mosquitoes are responsible for the disabling disease, filariasis, no doubt a great reduction in the numbers of mosquitos in villages can be secured quickly.

The question of screening is a difficult one in Samoa. Samoan "fales" do not lend themselves well to screening. At the Samoan hospital a number of small screened cubicles, just large enough to accommodate a single patient, have been built in three fales, at a cost of about \$40 each. Samoan chiefs, "faifeaus," and other well-to-do natives could provide themselves now with similar health-protective cubicles, to be used as sleeping spaces for their families, if the idea appealed to them and they thoroughly appreciated the importance of protection against mosquitoes. As things stand, there is little prospect in most villages of preventing such mosquitoes as

are in flight from becoming infected. Purely as a matter of comfort, a good many Samoans have taken to mosquito nets, principally to prevent annoyance by flies in the daytime, although the nets are also generally used at night by those who own them. The more affluent of the natives provide themselves with regular mosquito bars; the others used to offer all sorts of pretexts to obtain uncut rolls of gauze which they would fashion into improvised mosquito bars. Gauze is only issued by the health department in cut pieces, which will probably be used, principally, at any rate, for surgical dressings. Last year the desirability of promoting the use of gauze for this purpose was recognized, with the result that the government of American Samoa has during the past year sold uncut rolls to natives at cost. About 800 rolls have been sold. Mosquito bars, at best, do not offer good protection, but it seems advisable to promote the idea that protection is necessary.

No entomological studies have been made during the past year. According to Lambert, it has been shown in Samoa, the Ellice Islands, and Fiji that the *Aedes variegatus* is the principal, if not the only, vector of filariasis. The Gilbert Islands probably became infected from the Ellice Islands. Rotumah and the Cook Islands probably have the same vector as the neighboring islands, the *Aedes variegatus*.

Lambert's remarks on the distribution of filariasis in the South Seas are of interest. He says:

There are two varieties of filariasis recognized in the South Pacific—nocturnal, or periodic, and nonperiodic. No difference has been found morphologically between the two, neither in the microfilaria, in their parent worms nor in their clinical manifestations. The question of periodicity is said to be due to the habit of the insect vector. Roughly, nocturnal filariasis is confined to Melanesia, where its occurrence has not been minutely studied, as it is not a widespread clinical entity. The exception to this condition is found in the New Hebrides, which is Melanesian, where filariasis is widespread and a source of great morbidity. Nonperiodic filariasis occurs in all the islands east of 170° of east longitude, which corresponds with the region from which malaria is absent.

## PART II

### EXPERIMENTAL TREATMENT OF FILARIASIS

In February, 1928, we began experiments to determine what drugs or chemical substance, if any, might reveal power in high dilution to kill filarial embryos in warm blood smears under the microscope. A list of chemical agents to be tested was drawn up and the search was intrusted to Chief Pharmacist's Mate A. W. Jones, United States Navy, who was then in charge of the central laboratory. As a preliminary step, a survey of the bloods of members of the native Fita-fita guard was made to determine what individuals could later

be sent for and used as donors of blood regularly containing numerous filarial embryos. Night and day examinations were made. There is no particular periodicity about the appearance of embryos in the peripheral circulation in Samoans, but for convenience and noninterference with regular activities the early work was done as a rule between 8 and 10 p. m.

After a number of other substances on the list had been tried, among which phloroglucin in dilutions as high as 1 to 1,000 was the only one which seemed to have any lethal effect, oil of chenopodium was finally reached. A watery extract was tried which was made by grinding 1 gram of oil with an inert substance and shaking up in 1,000 c. c. of normal salt solution. A drop of this extract mixed with a drop of fresh blood appeared to have the power of killing filarial embryos in from 5 to 15 minutes, whereas in control slides of the same blood mixed with normal salt solution and kept under the same conditions the embryos remained actively motile for 10 or 12 hours and longer. Later it was found that oil of chenopodium, even when added directly to blood on a slide, by no means regularly interfered with the motility of filarial embryos. Worms which came in contact with a droplet of the oil apparently died; those which did not remained motile. Meanwhile five dogs, weighing from 20 to 40 pounds, were given intramuscular injections of oil of chenopodium which averaged a little more than 70 per cent ascaridol. No apparent harm resulted when the injected dose was increased to 1 c. c. in the cases of the larger dogs.

Three patients with filariasis in the Samoan Hospital were selected for study of the results of intramuscular injections of the oil. Two were men who had filarial fever. The other had moderate elephantiasis of the scrotum. All three had filarial embryos in the blood. The first injection consisted of 3 minims. The drug caused no reaction and the injections were not particularly painful, so two days later each was given an injection of 5 minims. In each case this was well tolerated, so, two days after that, an injection of 10 minims was given. There were then a number of volunteers among filarial subjects, both men and women. The clinical work was transferred to the central laboratory for convenience. Presently Chief Pharmacist's Mate Jones had under the experimental treatment more than 20 patients in various stages of the disease; some with marked elephantiasis; some with glandular enlargement only; some with frequently occurring attacks of filarial fever; and a few with filarial embryos in their blood, but who had developed no other objective or subjective symptoms. Shortly it became apparent that for most patients one injection a week would be all that could be tolerated without too much interference with the patient's activi-

ties. After observing the first few cases the initial dose was set at 0.5 c. c. Usually that did not cause a severe reaction. If not, the second intramuscular injection of 0.75 c. c. was given one week later. If that was well tolerated the dose was increased to 1 c. c. for the third injection, to 1.5 c. c. for the fourth, and to 2 c. c. for the fifth. As the work progressed it was found that some of the patients had very severe general reactions, consisting of chills, fever of 102° to 103° F., severe headache, and weakness. In some cases numbness of the feet and legs, or of the whole body, was described. These reactions began in most instances between 24 and 30 hours after the injections. About a third of the patients had severe pain and swelling in the buttock at the site of the injection. As the work went on it was found that a patient might have a very severe reaction after the first injection, although usually not. Some of the patients had three or four weekly injections before one was reached which produced a severe general reaction. Some had local pain and tenderness and some did not. Some patients had very severe reactions from one or more of the first five injections, after which they were able to take up to 2 c. c. without any particular reaction. This did not prove to be the general rule, and later we found that up to doses of 1.5 c. c. there was no constant relationship between the size of the dose and the severity of reactions.

Almost all of this first group of patients began to tell their friends that they were being helped greatly by the new procedure, and that led to an increasing number of requests for treatment. In October Lieut. H. H. Carroll, Medical Corps, United States Navy, who had become interested in the apparently good results of the treatment, volunteered to manage a special clinic for the observation and treatment of filarial subjects. Thursday mornings were set apart for this. The number of applicants increased so much from week to week that in less than a month Doctor Carroll was swamped, and Chief Pharmacist's Mate W. A. Washburn, United States Navy, our statistician, volunteered to assist. In a few more weeks it became necessary for the public health officer also to take an active part in the work. He, with the assistance of a native Samoan nurse, assumed treatment of the women patients, while the male patients, of whom there was a greater number, were divided between Doctor Carroll and Chief Pharmacist's Mate Washburn. A standard method of recording histories, objective data, and the results of injections was adopted. Unusual cases were considered by the entire staff. A few bed patients and two of the Samoan nurses, who were incapacitated from time to time by attacks of filarial fever, were treated at the Samoan Hospital by Lieut. Commander L. N. Hart, Medical Corps, United States Navy, who was in charge of the hospital. His

successor, Lieut. O. A. Smith, Medical Corps, United States Navy, is continuing the practice.

When the number of patients attending the central filariasis clinic had increased to about 250, the results up to that time were analyzed, and mimeographed copies of instructions regarding diagnosis, recording of data, and the method of conducting the new form of treatment were distributed to district health officers. A copy of these instructions, together with the form for recording cases, is appended. One by one the four chief pharmacist's mates serving as district health officers were instructed in the central clinic, and thereafter the treatment of patients living in district villages in the several districts was left to them, thus reducing the number of patients in attendance at the central clinic. Previously many patients walked long distances, when able, to receive the treatment, and some visited relatives in villages near the clinic for this purpose.

The records of patients transferred to district clinics were transferred with them. We have at present the case records of 233 patients in the central clinic, and according to reports for May, 1929, there were 169 in the district clinics. These are all cases in which the diagnosis of filariasis has been established by reasons of elephantiasis, by history of typical attacks of filarial fever, or by detection of filarial embryos in the blood. There have been a good many other patients in attendance at the central clinic in whose cases definite evidence of filarial infection has not been obtained. We do not know how many active cases of filariasis there are in the central district, but we have probably seen most of those in whom the disease has already caused disability. The ages of patients range from 16 or 17 years to old age. Few new cases are being admitted for their first treatment from week to week now.

The question arises: Is it wise to give the injections to patients who are beginning to develop clinical manifestations of filariasis, assuming that the ascaridol kills worms and causes acute inflammatory reactions in tissues where they reside? The first answer that comes to mind is: We will not know what results can be secured until the treatment has had adequate trial over an extended period of time. The second is: That patients who were seriously crippled by the filarial infection in advanced stages of the disease appear to have been greatly benefited in the course of a few months, particularly by relief from frequently repeated and disabling attacks of filarial fever. Those with elephantiasis appear to have obtained that relief without increased damage to the affected parts. We have not sought patients with microfilaria in the blood who have not yet developed clinical manifestations, chiefly because at present we would be without means of evaluating the results in such cases. A number of such patients have

been anxious to have the injections, and they have been included in the experimental series to note the difference, if any, in the character of ensuing reactions. Time may prove that patients treated before the advent of attacks of acute lymphangitis will benefit most by the treatment, but we do not know that now. One bad feature of the situation is that our patients continue to be inoculated by infected mosquitoes, but at any rate, if there are living worms in a body, it appears justifiable to attempt to destroy them, for eventually they will be destroyed anyway. So far as we have gone, the apparent destruction by the drug appears to be less harmful than the deaths of worms from time to time from other causes which the repeated attacks of filarial fever probably represent.

We have not had opportunity to conduct a series of control injections with subjects known not to have filarial worms in their bodies in order to study the character of reactions produced in them by ascaridol. The only persons in Samoa who would make fair controls are white men recently arrived from the United States. Up to this time we have not sought volunteers from among them for this purpose. Neither does the literature, so far as we are aware, describe any such reactions as we have observed with our Samoan patients, nor were similar reactions noted by Salant, Nelson, Livingston, Hall, and Schillinger following subcutaneous, intramuscular, and intravenous injections of oil of chenopodium into rabbits, guinea pigs, cats, and dogs in studying toxicity and determining minimum lethal doses. Lambert also tried oil of chenopodium intramuscularly and intravenously for whipworm in man. It appears that for intramuscular injections he used a mixture prepared according to Heiser's formula for preparing chaulmoogra oil for intramuscular injection in leprosy. This mixture consisted of oil of chenopodium, 60 c. c.; camphorated oil, 60 c. c.; and resorcin, 4 grams. It was used in two cases in doses of 4 and 10 c. c., and in another case 3 c. c. of the oil of chenopodium, undiluted, was used. In all three patients there were no local signs or symptoms at the site of injection. The first and third patients showed no signs whatever, while the second showed the typical symptoms of absorption of oil of chenopodium which occur from oral administration in large doses, indicating that the dose was excessive. The drug was injected intravenously in three cases in doses of 2, 1.5, and 1.5 c. c. The patients showed an immediate syncope, which lasted for a few minutes, the pulse rate dropped, and there was vomiting. These symptoms, however, passed off quickly, and by the next day all the patients had returned to normal.

We did not know, when we began our experiments in Samoa, that the oil of chenopodium had ever been injected into man intramuscularly or intravenously. Later Capt. M. A. Stuart, Medical Corps,

United States Navy, kindly searched the literature for us. We have observed no toxic symptoms from the oil of chenopodium in the doses we have used. In one case, several months ago, the patient tasted oil of chenopodium in the mouth about 30 seconds after the injection and felt faint. The pulse was normal and the faint feeling was probably of psychic origin. We concluded that the needle had penetrated a vein. Since then precaution has been taken after the needle is inserted to create a vacuum in the barrel of the syringe and look for blood before injecting the oil. There has been no recurrence of such an incident. Abscess has developed at the site of infection in one instance. The case was treated in the western district. The patient continued treatment in spite of the abscess.

An analysis of 338 case records of patients living in the central and western districts shows that 58, or 17 per cent, have received 10 or more injections; 95, or 28 per cent, have had 5 to 9 injections; and 185, or 55 per cent, have had less than 5 injections.

Experience has shown that some patients can not take an injection every week. Occasionally a severe general reaction lasts five or six days. After a severe reaction, some patients, especially women, stay away from the clinic for two or three weeks. A good many patients, apart from a number who have suffered severe reactions, have been disposed to stop treatment after five or more injections, because they were relieved of their previous symptoms and felt that further treatment was unnecessary. Perhaps 10 per cent of the patients have discontinued treatment after experiencing an unusually severe reaction. Some of those have subsequently resumed treatment. Samoan psychology enters into the situation. They will do as they please about treatment for any disease. For example, in many instances they have been anxious to have a patient ill with pneumonia taken to hospital, only to demand two days later that the patient be taken home because he is no better. The same thing is true of far advanced cases of tuberculosis. Reasons given for missing a week or stopping treatment vary. Few men or women will stay away from a church meeting for the sake of reporting in on clinic day. Other reasons given by men for absence are fonos (village conferences), village work (communal system), stormy weather, and bad condition of trails. Illness of some member of the family often causes women patients to miss from one to several weeks in succession. Women patients are particularly apt to skip a week and sometimes two weeks after a severe reaction. In general, patients with elephantiasis are more faithful in their attendance than those who have not yet developed elephantiasis. Few of the latter seem to understand that they are in danger of developing that disfiguring and disabling complication.



Samoans have not yet learned to worry about the future, at least not about their future on earth. As soon as a few injections have apparently put an end to their frequent attacks of filarial fever, various unimportant matters suffice to deter them from coming back for more treatment.

The 338 case records referred to above include the cases of 120 women and 218 men. Of the women, 54, or 45 per cent, and of the men, 118, or 54 per cent, have elephantiasis. At the time treatment was begun, 60, or 50 per cent, of the women patients had filarial embryos in the blood, and 19, or 35 per cent, of the women with elephantiasis have given positive blood smears constantly or from time to time. Twenty-five of the women under treatment neither have given positive blood smears nor have they elephantiasis. Diagnosis in their cases has been based upon regular attacks of typical filarial fever, with glandular enlargement or a varicose condition of the lymphatics. As a matter of fact, the manifestations of the disease are so constant and so well known to the natives that, with few mistakes, they are capable of recognizing the symptoms.

At the time treatment was begun, 124, or 57 per cent, of the men patients had filarial embryos in the blood, and 60, or 51 per cent, of the men with elephantiasis have given positive blood smears. Thirty-six of the men under treatment have neither elephantiasis nor have they shown filarial embryos in the blood.

Thirty-nine of the men without elephantiasis noted the first manifestations of the disease less than 5 years ago; 11, from 5 to 9 years ago; 5, from 10 to 14 years; 3, from 15 to 19 years; and 6, more than 20 years ago. Forty-three men with elephantiasis noted first symptoms less than 5 years ago; 29 have had symptoms for 5 to 9 years; 21, for 10 to 14 years; 7, for 15 to 19 years; and 16, for 20 or more years. Thirty-three of the women without elephantiasis date the onset of symptoms less than 5 years back; 12 noted first symptoms between 5 and 9 years ago; 3, between 10 and 14 years; 2, between 15 and 19 years; and 2 have had symptoms for 20 or more years. Nineteen of the women with elephantiasis first became aware of the disease, filariasis, less than 5 years ago; 13, between 5 and 9 years; 5, between 10 and 14 years; 7, between 15 and 19 years; and 4 believe they have had symptoms for 20 or more years.

We can not at this time evaluate accurately the results of the experimental treatment, but the outlook is very encouraging. Most of the patients who have had as many as 10 weekly injections of ascaridol consider that they have been greatly benefited by the treatment. Many of those who have had less than 10 injections appear to be in much better physical condition than they were. Perhaps the most prominent indication of improvement is the regularity with

which, after a course of injections, patients state that they feel much stronger, can do work which they had not previously been able to do for from one to several years, and are able to walk greater distances than formerly. Improved physical appearance, evident to an observer, seems to confirm such statements. We have, besides, the testimony of friends and relatives to confirm statements of the patients that their capacity for working and walking has increased. Nearly all patients who have been the victims of frequent attacks of filarial fever have ceased to have such attacks, often as early as after the fifth injection. There have been a very few exceptions; not so many as might be expected. Less than a dozen of 153 patients, who have continued their treatment more or less regularly to the extent of taking five or more injections, have had recurrences of natural "mu mu" and "pueia," and in all but three cases such attacks have been of very infrequent occurrence in the course of several months since treatment was begun, whereas formerly disabling attacks occurred once a month or oftener.

What the ultimate effect of the treatment upon elephantiasis will be we can not state. It is conceivable that an elephantoid limb may increase in size as a result of the injections if we accept Manson's ideas regarding the sequence of events leading to elephantiasis and the part played by local inflammations incidental to the destruction of worms.

The reactions resulting from intramuscular injections of ascaridol are very suggestive of the destruction of adult worms. The symptoms observed in those reactions are in no respect essentially different from those of natural and chance attacks of filarial fever. The symptoms as noted in clinical records have been, in the order of prominence, chills or chilliness; slight to high fever; severe headache, lasting from several hours to two or three days, sometimes frontal but more often general; backache, especially in the small of the back; pains all over the body; prostration; sensations of numbness, especially in both legs and feet, sometimes in the arms and hands, and occasionally in other parts of the body. Persistent pain in the epigastrium has been complained of by a small percentage of the patients, perhaps 10 per cent. Patients who experience this symptom usually have it with every reaction; that is, if they have more than one severe reaction. Such patients almost always give a history of epigastric pain with their attacks of filarial fever which occurred before they began to take the injections. The same is true of numbness. We are not sure that the Samoan word used to describe the feeling is accurately translated. Probably "paresthesia," rather than "anesthesia," more correctly describes the sensation.

The character of the general reaction resulting from an injection of ascaridol seems to be determined by the symptoms and character of attacks of filarial fever previously experienced by that patient. The severity of the reaction probably depends to a great extent upon the numbers of living adult worms resident in the host and their accessibility to the action of the ascaridol. Some of the patients experience photophobia and congestion of the conjunctivae during natural attacks, and likewise during reactions to ascaridol. In a few cases nausea and vomiting have been noted, but in most cases there are no symptoms referable to the stomach.

For purpose of administration we have defined the native word "mu mu" as follows: A localized acute inflammation, characterized by pain, tenderness, heat, redness, often swelling, and sometimes induration. The inflammation may be in a muscle, in subcutaneous tissue, in a breast, or in lymphatic tissue, especially in a groin, above or below Poupart's ligament; in a popliteal space or about an elbow, or, less commonly, in an axilla. In a fair proportion of the cases no such local inflammation is manifest, but it is possible that mu mu nevertheless occurs in some deep part of the body where local signs and symptoms can not be recognized, especially in retroperitoneal tissue adjacent to the thoracic duct, in the pelvis, and in the mediastinum.

Following an injection of ascaridol, patients with elephantiasis more often than not experience mu mu in the already hyperplastic tissue if a severe reaction develops, which by no means always happens.

Patients differ greatly with regard to the frequency with which they experience severe reactions after medication. In the first place, the incubation period varies a great deal. The injection itself is rarely painful. There is seldom any local reaction at the site of injection in the buttocks for several hours after the injection is made. In the majority of cases the patient experiences no pain locally for 24 to 30 hours. Occasionally, however, it begins in 2 to 3 hours. Sometimes it is delayed for more than 48 hours, while after many of the injections no pain at all is experienced. Curiously, the local reaction seems to be intimately related to the general reaction. As a rule, if the general reaction is severe the local reaction is also, and severe pain, accompanied by swelling and induration of the tissues of the buttock, develops. The local reaction usually begins concomitantly with the initial symptoms of the general reaction—chill, fever, or headache. There are some exceptions to this rule; there may be a severe general reaction with very slight local disturbance, and vice versa. Severe local pain may be produced occasionally in the absence of a general reaction by accidental contact of the oil with

a nerve, as may be the case with an injection of succinimide of mercury. Immediately acting and irritating chemical qualities, such as those of salts of mercury, however, are not manifested by the oil of chenopodium.

There is no close correlation between the size of the injected dose of ascaridol and the resulting reaction. Some patients experience a severe reaction from the initial dose, 0.5 c. c., but the majority do not. Patients who have been experiencing frequent and severe attacks of pueia and mu mu, however, are almost sure to have a severe reaction from one of the early injections, and it appears that patients who have many filarial embryos in the peripheral circulation are also especially prone to severe reactions with the earlier injections. This is by no means an invariable rule. Some patients who have negative blood smears and attacks of filarial fever only at very infrequent intervals have one or more very severe reactions. It is possible in such cases that adult filarial worms were reached and destroyed by the ascaridol, despite the absence of recent clinical manifestations. We have no means of demonstrating, however, that the adult worms are killed by the drug.

As treatment progresses from week to week and the quantity of oil of chenopodium at each injection is increased by 0.25 to 0.5 c. c., severe reactions in most cases become less frequent. Most patients who had one or more severe reactions from 0.75 and 1 c. c. are able to take 1.25 and 1.5 c. c. dose repeatedly without experiencing another really severe general reaction. Some patients have taken several injections of 2 c. c. in the later part of a course of 10 or more injections without having much discomfort. Exceptional cases are seen from time to time. For example, a woman, 45 years old, with no elephantiasis, who had been having frequent attacks of filarial fever, with mu mu in the right breast, and whose blood constantly contains many filarial embryos, had a slight reaction after the first injection of 0.5 c. c. Then from 8 successive weekly injections, the last 3 consisting of 1.5 c. c., she had no local or general disturbance. The following week, beginning 27 hours after a dose of 1.5 c. c., she had a very severe general reaction, starting with a rigorous chill and followed by high fever for 3 days. Other symptoms were severe frontal headache, complete loss of appetite, pain all over the body, slight numbness in the hands, a little dyspnea, and weakness. The weakness lasted for nearly two weeks. In that particular instance the local reaction, consisting of severe pain in the buttock, began 4 hours after the injection and lasted for 4 days, whereas the general reaction did not appear for 27 hours. As remarked above, the onset of the local reaction is usually concurrent with that of the general reaction. This patient took no more injections for three weeks.

Treatment was then resumed with 0.5 c. c., and increased to 1 c. c. the following week, without producing any reaction, local or general. She teaches sewing three afternoons a week in the public school and proposes to take an injection henceforth every two or three weeks. She speaks English. She says the treatment has done her "a world of good." She has had no attack of filarial fever since treatment was begun, apart from the one severe reaction mentioned above. She is unquestionably stronger and more fit for work, and her work has not been as frequently interrupted as formerly.

Space does not permit and the experimental treatment has not been carried on long enough to justify us in going into clinical details of many cases, but two more will be mentioned as bearing on the immediate effects of ascaridol. A man, 42 years old, whose blood constantly showed the presence of filarial embryos, but who had not experienced any subjective manifestations, began treatment in February, 1929. The first dose, 0.5 c. c., caused a moderately severe reaction, consisting of fever, pain in the abdomen, pain in the back of the neck, and nausea, beginning 30 hours after the injection, and slight pain locally which persisted for two days. He had been having pain in the small of his back and in the back of his neck at intervals for about 10 years. After his second injection, consisting of 0.5 c. c., and again after the third, consisting of 0.75 c. c., and the fourth, consisting of 1 c. c., he had slight to moderate general reactions. Since then he has taken at weekly intervals 1 c. c., 1.5, 1.5, 1.5, 2, and 2 c. c., without experiencing any discomfort. His blood continues to show the presence of filarial embryos. It may be that the ascaridol, at least in the later doses, has not happened to reach the reproducing female worms.

Fresh blood smears are taken from each patient once a week. In many cases bloods formerly positive every week have become negative after several injections. We can not draw any conclusions from that fact, because there comes a time in many cases when microfilariae disappear from the peripheral circulation, especially in cases where there is elephantiasis. The continued presence of microfilariae, of course, shows that the treatment has not ended the infection.

By contrast, the case of a man 39 years old is interesting. He has huge elephantiasis of both legs, including the thighs, which is unusual. Elephantiasis began to develop about 18 years ago. During the past 15 years he has had attacks of fever with what he calls numbness in his legs about twice a week. Prior to beginning treatment he was incapable of productive labor. He began treatment November 8, 1928. The first five weekly injections of oil of chenopodium, with increasing doses from 0.5 c. c. to 1.25 c. c., caused no local or general reaction. After the sixth dose, which consisted of

1.25 c. c., he had a severe reaction with onset 36 hours after the injection. The symptoms were chilliness, followed by fever which lasted for 6 days. Concurrently he had slight pain at the site of the injection, which also lasted for 6 days. The following week a similar dose caused slight fever and numbness in both legs, which developed 17 hours after the injection and lasted for 5 days. The injected buttock was painful for nearly two weeks. Nevertheless, he came back for his weekly dose, which, in view of the reaction, was reduced to 1 c. c. This caused a severe chill 10 hours after the injection, followed by fever and headache. Severe vomiting occurred about 32 hours after that injection, and he had considerable pain at the site of the injection. The following week he returned for treatment and requested an injection, but was advised to discontinue them for two weeks. He gave as his reason for not wanting to miss a treatment that he had had no "pueia" attacks for two months. At that time he was able to do a little work, something he had not been able to do for a long period of time without bringing on fever, pain, and numbness in his legs. After two weeks, treatment was resumed with 0.5 c. c. and increased to 0.75 c. c. without causing a general reaction, although the second injection caused a slight local pain which lasted for two days. This made in all 10 injections, and it was decided to take him off treatment and watch the results for a while. That was on January 24, 1929. He still appears regularly every week for observation and receives an injection of the ethyl esters of chaulmoogra oil, which causes no particular disturbance. This is given largely to insure faithful attendance. During the past five months he has had no recurrence of filarial fever. He works every day and walks several extra miles on clinic days. He says there is no doubt that his legs are lighter and do not bother him in walking as they did before. There is no difference in circumference. The measurement of the right leg below the knee at the point of greatest circumference is 24 inches and of the left leg 23 inches. Blood smears have been taken at about weekly intervals since December 11, 1928, some in the daytime and some at night. Microfilariae have never been found. At present there are wrinkles and grooves in the skin above both knees and the elephantoid tissue is softer. He thinks the legs are softer below the knees also. At any rate, his elephantiasis is no worse.

This takes us back to the theoretical consideration, mentioned on a previous page, that the injections of ascaridol by inducing inflammatory reactions in elephantoid tissue might increase the size of the affected limbs or parts. The treatments apparently have not done that. Measurements in the 172 cases of elephantiasis, under more or less regular observation, show small variations from week to week, but there has been no progressive increase in the cases of

those who have had elephantiasis for several years. Three patients who have begun to develop elephantiasis during the past year and who applied for treatment on that account are showing some increase in measurements from month to month. A few others who were in the early stages of elephantiasis and have ceased to have attacks of pueia and mu mu, as well as reactions from ascaridol, show some reduction in the size of affected limbs. Many of the patients think the affected limbs are smaller. The reason for that is probably that they feel less burdensome. There is no doubt that many of this group of patients are more energetic and get about more than they did before taking the treatment. If the ascaridol has any effect, one would expect it to be limited to action on the worms, and there is no reason to expect any decrease in the size of elephantoid limbs as a direct result of drug action. In a good many of the cases, including those of many years' standing, the elephantoid parts feel softer upon palpation. It is possible that when the patients cease having attacks of acute lymphangitis, as they do under treatment in most cases, the diseased lymphatics are able gradually to bring about to a variable extent the removal of the exudates of previous inflammatory attacks.

We have had two cases which appear to be examples of unusual or rare phenomena which may result from ascaridol injections. In the first of these the patient was a man, 46 years old, with elephantiasis of the right leg of about six years' standing, who was having attacks of filarial fever, consisting of chills, fever, and pain in the right thigh and leg, about once a week. His blood contained filarial embryos occasionally, but smears, taken in the daytime, have been negative. One night specimen has been positive. His acute attacks confined him to bed from two or three to five days each. He is badly disabled by the disease. The first injection of ascaridol, 0.5 c. c., given November 30, 1928, caused no local or general reaction. The next dose, 0.75 c. c., was followed by a severe reaction, which began about 20 hours after the injection. The symptoms began with chill, high fever (103° F.), headache, and pain in his back. Two or three hours later his left eye was painful and the tissues about the eye began to swell rapidly, as they might have done from a blow or the bite of a centipede. In three hours the eye was closed entirely by edematous swelling. The swelling subsided largely in 48 hours, but some swelling remained for more than a week, and then the inflammation went on to suppuration, for which a small incision was made about a month later. A few drops of pus were evacuated. Since then his eye has not caused him any trouble. That eye was badly bruised in a game of Rugby when he was 14 years old. The inference is that the ascaridol, acting on a filarial

worm in the tissues about the tear duct, brought on localized sudden inflammation. Since then he has had 14 injections, ranging from 0.75 to 1.25 c. c., with moderately severe reaction after 3, mild reactions after 9, and no reaction after 2. The elephantoid leg seems to have increased about 1 inch in circumference during the past six months, although the patient thinks it is just the same. The leg swells at times and then becomes reduced in size. He continues to have attacks of mu mu in the leg, but he says they are less severe and come at longer intervals. This is one of the comparatively few cases in which we have been unable to note any definite improvement. Most of the patients have entirely ceased having attacks of pueia and mu mu.

The other case with unique characteristics was that of a man, 45 years of age, first seen in Nuuli by the district nurse. He had a filarial abscess developing in the back in the scapular region and another in the right buttock. He could not be persuaded to enter the hospital. A few days later the nurse, with the assistance of the Hospital Corps man on ambulance service, incised the abscess and uncovered pus. He had no elephantiasis, but microfilaria were found in his blood. The following day he was given an injection of 0.5 c. c. of the oil of chenopodium in the left buttock. His temperature declined from 101° or 102° and reached normal three days later. There was nothing to suggest any mental peculiarity. The injection caused no local pain. Four days later the patient suddenly became violently maniacal, and several men were required to restrain him, night and day. He was at times incoherent in speech or nonsensical and at other times given to outbursts of rage in which he endeavored to attack the attendants and other patients. These symptoms lasted for about five days, after which he became comparatively quiet. His relatives were then controlling him at home. Two weeks later he was superficially rational but illogical and easily irritated. Now, six months later, he is apparently free from mental disturbances, except, perhaps, he is more easily irritated than he used to be. He refused further treatment with ascaridol. Mental disorders are very uncommon among Samoans.

With regard to deaths, as mentioned before, filariasis was recorded as the primary or underlying cause of eight deaths in 1928. None of the patients who died that year were given oil of chenopodium. In 1929, up to July 1, two of the patients who received one or more injections have died. The first was a woman, about 60 years of age, who had been having sharp attacks of angina pectoris, with pain in the precordium and epigastrium, for several years. She had filariasis, and the infection may have been the underlying cause of coronary sclerosis. She was given four injections of oil of chenopodium, and had a severe reaction after the third and also after the fourth, with



chills, high fever, and pain in the epigastrium, accompanied with marked prostration. The reaction began suddenly six hours after the fourth injection. Forty-eight hours after the injection she felt much better, but the next day she had a severe pain in the epigastrium, which persisted. She died during the night. Her relatives thought the effects of the injection had worn off and that the attack which killed her was exactly like those she had been having for several years. In several of the eight cases in which death occurred during the previous year a similar story of the last illness was obtained.

The other death was that of a man whose age was estimated to be 50 years, although he had the appearance of a feeble old man. He had been blind for five or six years and had taken no exercise. He was emaciated and feeble. For about four years he had been having attacks of pueia and mu mu in the leg. His blood smears over a period of four weeks were all negative. He was given four injections of the oil of chenopodium in the usual doses. After the first he had a general reaction, which he said was milder than his usual pueia attacks. That began 36 hours after the injection. Forty hours after the second he had a chill and fever lasting for 12 hours. He had mild general reactions after the last two injections, with the same tingling sensations previously felt in various parts of the body. He had no pain at any time at the site of injections. One week later he had a natural attack of pueia and skipped treatment. Twelve days after that he contracted pneumonia, and died from that disease on the fourth day of the infection. There is no reason to believe that filariasis or the treatment had anything to do with causation of the pneumonia.

The following form is one with which district health officers, Samoan nurses, and sanitary inspectors are required to be familiar:

**INSTRUCTIONS FOR THE MANAGEMENT OF FILARIASIS CASES AND TREATMENT WITH  
OIL OF CHENOPODIUM**

A clinical record sheet shall be kept for every patient who is given the ascaridol (chenopodium) treatment, in accordance with the form contemplated herein.

**CENSUS DATA**

The following will be recorded:

Name: ----- Sex: ----- Age: ----- Married or single: ----- If female, how many children: ----- Age of youngest child: -----	<b>Patient's home village:</b> ----- If elsewhere, name of village where visiting: -----
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In the case of a woman give the approximate date of the last menstrual period: -----

## HISTORY

**Has the patient had definite attacks of pueia?**

*Definition of pueia:* This is the native's word to cover chill, fever, malaise, etc., occurring in filariasis. Doubtless natives sometimes think these symptoms are due to this disease when in reality they are due to some other infection—tuberculosis, for example. As we use the term "pueia attack" we mean to include all the symptoms which may be associated with such an attack. The histories of cases taken in the central clinic show that the following symptoms have been recorded:

Chill; sometimes repeated chills.  
 Chilliness.  
 Fever (slight, moderate, high).  
 Sweating.  
 Headache (note location—frontal, temporal, vertical, occipital).  
 Backache.  
 Pains all over the body.  
 Numbness (state parts affected).  
 Tingling (state parts affected).  
 Weakness (prostration).  
 Nausea.  
 Vomiting.  
 Epigastric pain.  
 Congestion of the conjunctiva.  
 Photophobia.

**When did the patient begin to have pueia attacks?**

**How often have they occurred in previous years?**

**How often have they occurred during the past year?**

**How long do the attacks last?**

**Does the patient have to go to bed during an attack, and if so, for how long?**

**What is the first symptom noticed by the patient when a pueia attack comes on?**

**State the symptoms of the attack in the order in which they appear.**

**Are some of the pueia attacks accompanied by mu mu? If so, what proportion of the attacks?**

*Definition of mu mu:* A localized acute inflammation, characterized by pain, tenderness, heat, redness, often swelling, and sometimes induration. The inflammation may be in a muscle, in subcutaneous tissue, in a breast, or in lymphatic tissue, especially in a groin or above or about an elbow.

**In what parts of the body and in what tissues has the patient had mu mu?**

**How often have the attacks of mu mu occurred in previous years and during the past year?**

**What has been the duration of mu mu attacks?**

**Describe the signs and symptoms of mu mu attacks as they have occurred in this case.**

**Has the patient had any filarial abscesses? If so, when, how many, and where located?**

**Has the patient any elephantiasis (Samoan word, tupa)? If so, when did the patient first notice elephantiasis?**

**What parts of the body are affected?**

**Is the enlargement still increasing? If not, how long since has it apparently been arrested?**

- Does the elephantoid part become larger during attacks of pueia or mu mu?  
 If so, does it return to its former size after the attack?  
 Does the affected part or limb get larger upon exertion or after working hard?  
 If so, does it get smaller after resting?  
 How much work or walking can be done without bringing on an attack of mu mu or pueia?  
 Over what period of time did the elephantiasis develop to its present size?

#### EXAMINATION OF THE PATIENT

**Blood.**—Enter the result of each examination of the blood for the presence of the sheathed filarial embryos and specify whether the blood was taken day or night; for example, 3-28-29, day, positive.

**Weight.**—Record initial weight and weigh from time to time during treatment.

**Varicose lymph glands.**—Has the patient noticeable or palpable enlargement of varicosity of lymphatic glands, especially in the groins and above the elbows?

**Elephantiasis.**—Is there any elephantiasis? If so, record the measurements (circumference) of elephantoid and normal limbs in inches, as:

Right forearm.

Left forearm.

Above right elbow.

Above left elbow.

Right lower leg.

Left lower leg.

Care should be taken with each measurement to make sure that the tape is laid where the circumference is greatest.

In the case of elephantiasis of a forearm, how much is the hand affected?

In the case of elephantiasis of a lower leg, how much is the foot affected?

Are the elephantoid limbs hard?

Of which of the following types is the elephantiasis?

(a) General enlargement without much change from the natural shape of the limb.

(b) Fusiform enlargement with the greatest enlargement in the antero-posterior dimension.

(c) Irregular enlargement with folds, bulges, or masses.

Is there, or has there been, any involvement of the scrotum?

What is the condition of the skin of the elephantoid part? Is it smooth, rough, warty, or scaly?

What is the general condition of the patient—strong, weak, fat, well nourished, or thin?

Is there reason to suspect the patient has any of the following diseases?

Heart or kidney disease.

Tuberculosis.

Yaws.

#### PROGRESS OF THE CASE

After each intramuscular injection, record the resulting reaction as follows:

(A) General reaction—

Severity—0, X, XX, XXX, XXXX.

Time of onset in hours from the time of injection.

Enter the initial symptom and all others in the order of appearance. (Refer to the list of symptoms given above as occurring in pueia attacks.)

How many days did the general reaction last?

Was there anything suggestive of mu mu during the reaction?

If so, state location, severity, and duration, and mention the symptoms and signs.

(B) Local reaction—

State time of onset in hours after the injection.

Describe the pain as slight; moderate; severe.

How many days did the local reaction last?

Were the tissues of the buttock swollen?

Was there induration?

Did the local reaction cause the patient to go to bed?

Did it interfere with walking?

After 10 injections have been given, write a brief account of the patient's condition as compared with that previous to beginning treatment. Note in detail any apparent improvement, so far as possible, in the words of the patient.

GENERAL INSTRUCTIONS

In general, if a patient has not manifested signs of tuberculosis, heart disease, or active yaws and is not weak or emaciated, the course of injections may be given, provided there is evidence that the patient has filariasis.

The course may be given if filarial embryos are demonstrated in the blood, even though there may be no other indications of the disease.

With negative blood examinations the course may be given if there is a definite history of pueia attacks or attacks of mu mu, or if there is elephantiasis.

If the person requests the injections, although there is no evidence of filariasis, the injections may be given provided there are no definite contraindications, such as active tuberculosis, heart or kidney disease, active yaws, anemia, emaciation, or other serious condition. Such persons may be useful as controls in studying severe reactions.

Care should be taken in the case of young women to ascertain the date of the last menstrual period. The idea has doubtless spread that the injections may cause abortion.

The treatment should not be given to pregnant women, married or unmarried.

An injection should not be given during a menstrual period.

In all cases the treatment should begin with 0.5 c. c. of the oil of echnopodium. Injections should be given seven days apart.

Provided a severe general reaction does not occur (one that disables the patient for three or more days or one which involves high fever, severe pain, or some special symptom which may mean a serious condition), the dose should be increased by 0.25 c. c. each week.

If a prolonged or severe general reaction occurs, the patient may be advised to skip a week, or the dose may be reduced by 0.25 c. c., or the same dose as that given the week before may be given, depending upon circumstances. The dose should not be increased until it is clear that that particular sized dose is tolerated without undue suffering and disablement.

In many cases, early in the treatment, 0.5 or 0.75 c. c. has caused severe reactions, and later the same patient has been able to take 1 c. c. and even as high as 1.5 c. c. in injections without experiencing noteworthy reaction.

A dose of 2 c. c. should not be exceeded, for the present at least. Some patients do not tolerate more than 1 c. c.

*Treatment of severe reactions.*—In cases where medical or nursing attention is sought for severe reactions, provided stimulation is not indicated, one or two doses of phenacetin, 5 grains; aspirin, 10 grains; and codein, 0.5 grains,

may be given. A cool bath is indicated by very high fever. If the pulse is rapid and weak, 1 c. c. of adrenalin solution may be given hypodermically. Caffein, 2 to 5 grains, may be given by mouth, or 2 to 10 grains of caffein sodium benzoate may be given hypodermically. Aromatic spirits of ammonia may be given. An enema of strong coffee may be useful in overcoming prostration.

*Manifestations of poisoning by oil of chenopodium.*—A considerable proportion of patients taking full doses of chenopodium by mouth for worm infestations suffer the following minor side effects of the drug: Nausea, vomiting, tingling in the hands and feet, temporary deafness, or general depression. Severe intoxication is rare and usually follows gross overdosage. The initial symptoms are the same as the minor complaints, but progress into convulsions, tachycardia, fall of blood pressure, coma, paralysis of respiration, and death. The onset of symptoms may be immediate or may be delayed for seven or eight hours.

The above symptoms apply to oral administration. The only toxic symptoms which have been observed from the intramuscular injections are sudden onset of vomiting, a sensation of burning in the mouth accompanied by the taste of chenopodium, faintness, and dizziness. This may be due to a part of the injected dose getting into a vein, and for this reason it is very important always to pull back on the plunger of the syringe after the needle has been inserted and before injecting the oil. If blood is drawn into the syringe, pull out the needle and change the site of the injection. In all cases of this kind observed in the central clinic the symptoms have been very fleeting and the patient has felt perfectly well in a few minutes after the onset of the symptoms. In case the symptoms persist and the depression progresses, put the patient flat on his back, elevate the feet, and keep him warm. If possible, take his blood pressure, and if below 90 systolic, give 1 c. c. adrenalin hypodermically every 30 minutes for two or three doses, if necessary. In the absence of blood-pressure readings, a rapid pulse, pallor, and weakness are the indications for the administration of adrenalin as above. Strychnin sulphate,  $\frac{1}{50}$  grain, should be given hypodermically and also an enema of strong coffee. Give magnesium sulphate by mouth and see that the patient takes 8 ounces of fluid every hour.

*Supply of oil of chenopodium.*—Sterilized oil of chenopodium, ready for use, in 1-ounce bottles, will be furnished branch dispensaries as requested. Do not use rubber stoppers in the bottles. The oil of chenopodium acts on rubber. Sterilize a medicine glass and pour into it the oil which is to be loaded into the syringe. The needle should be 20-gage,  $1\frac{3}{4}$  inches long.

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#### TUBERCULOSIS IN AMERICAN SAMOA

By J. B. Phelps, Commander, Medical Corps, United States Navy

Tuberculosis is a serious problem in most of the South Pacific Islands comprising Melanesia and Polynesia. This is shown in the valuable summary of medical conditions in the South Pacific, published in 1928 by Dr. S. M. Lambert, of the Rockefeller Foundation, in his capacity as deputy central medical authority, Western Pacific High Commission. Lambert regards tuberculosis as the immediate cause of more deaths than any other disease in the Pacific. He has

never been able to find a truly native name for any of its manifestations. That is certainly true of the natives of American Samoa, except that the term, "mama pala," is very generally used by them to describe the advanced active cases. The words mean, literally, rotting of the lungs. This shows that in American Samoa the natives have in recent years at least come to the point of recognizing and distinguishing the disease in its later stages. But, as Lambert remarks, the absence of words in the languages of the Melanesians and Polynesians to describe the manifestations of tuberculosis tends to show that it is an imported disease. "The earliest travelers and missionary writers reiterate the claims of the natives that it was introduced by the whites." There can be little doubt about this. Wherever the white man has gone among aboriginal peoples he has carried venereal disease, distilled liquor, and tuberculosis.

With particular reference to the natives of American Samoa, if we can safely assume that tuberculosis was first introduced among them within the past century, the population has not reached the degree of immunological adjustment to the tubercle bacillus which the white peoples of Europe and North America have reached in the course of many centuries. The law of nature which determines the survival of the fittest is inexorable, and in every generation the tendency is for individuals who happen to be exposed to tubercular infection to die unless they come of stock which has more or less successfully coped with tuberculosis for many previous generations. Little by little, with the passing generations, families in which there is a lack of ability to develop immunity to the tubercle bacilli which have invaded their tissues die off without reproducing, so that in the course of centuries the propagating stock becomes relatively fit, from the immunological standpoint.

The Samoans have not yet reached this point, and that, no doubt, is one of the reasons why we apparently have a greater proportion of acute rapidly fatal cases among Samoans than among Europeans and Americans. But, on this score, too much should not be taken for granted. To offset the effect of the law of the survival of the fittest we have other conditions in Samoa, notably an abundance of sunshine and out-of-doors living conditions throughout the year. Personal contacts for the most part are not made under such dangerous circumstances as in crowded populous communities, and, in general, the diet of Samoans is probably not lacking in essential mineral substances or vitamins. From infancy on, most Samoans develop heavy skeletons and powerful large muscles. For some individuals, no doubt, the diet at times becomes deficient in one or more essential dietary factors.

It seems probable that a sufficiently prolonged and critical study of tuberculosis among Polynesians has not yet been made to determine just what biological relationships with the tubercle bacillus can be developed among them. Lambert notes that in making surveys of a few months in length over a group, even when examining large numbers of natives clinically, we find that the disease is not so apparent as the deaths from it would indicate. He accepts the usual explanation given for this; that is, the progress of the disease is so rapid it is not evident to a passing observer. He remarks that tuberculosis is the cause of 30 per cent of the deaths in the South Pacific Island groups.

In American Samoa in 1928 tuberculosis caused 23 per cent of total deaths. We see some cases in young adults as well as in children which run rapidly fatal courses. On the other hand, the more we investigate the more evidence we obtain of healed pulmonary lesions and healed tuberculous bone lesions. Moreover, since we have begun to be successful in getting some of the tuberculosis subjects to submit to prolonged treatment in the hospital, we have observed prompt response to rest, sunbaths, and carefully planned diets. Febrile cases have become afebrile and the patients have begun to gain weight.

New cases were detected and notified in 1928 as follows:

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Eastern, Tutuila.....	1	0	0	2	0	0	0	0	0	0	0	0	2
Central, Tutuila.....	9	2	0	0	3	1	1	0	2	4	3	2	27
Western, Tutuila.....	0	0	2	0	2	1	3	2	12	2	1	1	26
Oftu, Olosega.....	0	1	0	0	0	1	0	1	1	2	1	0	7
Tau.....	1	0	2	2	1	2	0	0	0	2	3	2	15
American Samoa.....	11	3	4	4	6	5	4	3	15	10	8	5	78

At first glance it might appear that efforts to detect tuberculosis cases were quite successful inasmuch as there were 78 recorded cases for 31 deaths from tuberculosis during the year—2.45 cases per death. The appraisal forms for city and rural health work, prepared by the committee on administrative practice of the American Public Health Association, in scoring all activities of a health department, allot 100 points to the control of tuberculosis. The value of the item, detection of new cases, is assigned 10 of the 100 points. The total credit of 10 is allowed if two or more cases are reported for each death during the year. Five points are credited for one case per death registered. On this basis our showing is not so bad. Nevertheless, there are no doubt a good many active cases of tuberculosis in the population that we do not know about.

Altogether, we may surmise that with the inauguration and systematic execution of well-planned tuberculosis-control measures

more and more incipient cases, which are not yet hopeless from the therapeutic standpoint, will be brought to light. A little thought makes it apparent that few cases in the early stages of the disease would be discovered in the United States if the population there were completely ignorant of the disease and its earlier manifestations. Early recognition of the disease requires not only that suspicious cases be brought to a physician's attention, but even then, repeated and thorough examinations are often required, together with X-ray studies and laboratory work to confirm or disprove suspicion.

Lambert expresses the view that the native has not arrived at a cultured stage at which a modern tuberculosis campaign would serve a useful purpose. "At present the best that can be done is to rid him of the debilitating diseases which lower his general resistance and make him an easier prey to tuberculosis."

In general, that is true enough. In American Samoa, however, we now have full-time health work sufficiently well carried on in all public health districts, at least to make possible the inauguration of a modern tuberculosis control campaign. A beginning has already been made. The members of this year's graduating class of nurses from the Samoan Hospital Training School have been instructed in all phases of the tuberculosis problem—pathology, immunology, early manifestations, differential diagnosis, prognosis, principles of treatment, and established principles of prevention and control. The older district nurses will be brought back to the Samoan hospital two at a time for short courses on tuberculosis and other communicable diseases likely to be encountered as rapidly as conditions in the field permit them to be withdrawn. We expect that the nurses will be able to teach a few of the more intelligent residents in each village enough about the disease so that tuberculosis committees can be formed within a relatively short period of time. At first, of course, such committees can do only the simplest kind of work. But from the beginning it should help if certain persons living in the village would agree to tell the district nurse of persons who have lost weight or energy, have a cough, etc. At present the hiding of cases away from the visiting nurse is a common practice in many villages. This is true not only of suspected tuberculosis but of yaws and other communicable diseases. The committee should serve usefully in observing whether the nurse's instructions regarding the care of sputum, contact with children, etc., are being followed. Such committees should aid in promoting hospitalization in cases determined by a medical officer to be suitable for such treatment. As progress is made along these lines, other useful activities can be developed gradually to assist the tuberculosis committees.



Two moving-picture films, three reels, were made available through the kindness of the National Tuberculosis Association. These pictures with films relating to sanitation, prevention of typhoid fever, flies, mosquitoes, round worms and hookworms, donated by the State Department of Health of Virginia, the United States Department of Agriculture, and the United States Public Health Service, were shown every Thursday night for several months. The pictures were shown regularly until the attendance began to fall off. Nearly all Samoans living in the central district saw the pictures at least once and many of them several times. Each showing was made the occasion for a short talk by the public health officer and the pictures were explained by the interpreter while being exhibited. First and last, a surprisingly large number of people from the eastern and western districts of Tutuila saw the pictures together, with not a few from the Manua group of islands. These pictures will be shown again during the coming year. That they have some effect was reflected in the increasing numbers of patients who presented themselves for worm treatment and also by the fact that a considerable number of the better-educated natives in the western and central districts came and brought their children for examination to find out whether they had any signs of tuberculosis.

Customs and habits among Samoans which are related to the spread of tuberculosis are chiefly the spitting habit and the kava ceremony. The floors of Samoan houses, fales, consist as a rule of small rounded pieces of coral gathered on the beach or of small pieces of stonelike gravel. The floors are covered with mats woven from the foliage of certain trees. The natives sit cross-legged on the mats and when they desire to expectorate they frequently lift the nearest corners or edge of a mat and deposit the sputum on the gravel or coral. The mats in a fale which houses a consumptive are likely to harbor many living tubercle bacilli.

Lambert points out that before the appearance of white missionaries among Polynesians kava root was prepared for the kava decoction by mastication, the root being chewed by one or more engaged in preparing the beverage and spat into the kava bowl. To him this alone is sufficient evidence that tuberculosis is new, for in the face of tuberculosis no people could have survived such a constant reinfection as such a custom entails. Even as the kava ceremony is conducted to-day among the natives of American Samoa, a single coconut shell of the kava drink being handed from one to another around the seated circle of guests at a meeting, there is great danger that tubercle bacilli will be disseminated by the common drinking bowl even though the root was prepared by grinding and not by mastication. Comparatively few of the Samoans have yet taken to the

use of dishes, glasses, cups, spoons, and forks. Food is mostly spread on pieces of banana leaves and eaten with the fingers. It is chiefly among half-castes that we have to deal with the problem of preventing the transfer of tubercle bacilli by dishes, spoons, etc.

Samoans as a rule avoid direct exposure to sunlight as much as possible. Whenever they are not feeling well they stay in the fales, the interiors of which are comparatively dark. Just what the basis of the rather general fear of sunshine is among the Samoans, by tradition or otherwise, is not altogether clear. Numbers of Samoans employed constantly in road work by the department of public works are forced to keep in the sunlight without protection other than their clothing for several hours daily. They seem to suffer no ill effects. White Americans play golf and other games in the open sunshine for hours daily, with improvement in their physical condition. The rays of the sun do not seem to burn as quickly or as extensively as during the summer, for instance, at Atlantic City, N. J. Individuals who have a certain amount of tan as a result of daily exposure to the sun on the island of Tutuila not infrequently develop an erythematous sunburn after a few hours' trip over water on board the station ship while going to and from one of the other islands. White people lose their tan quickly in American Samoa if for any reason they have to remain indoors for a few days. Not infrequently white persons here have to be advised to get out of doors because they are not getting enough sunshine.

Whatever the foundation of the Samoan fear of sunshine, it is perfectly clear that most Samoans who have tuberculosis do not get enough sunshine. In this connection Lambert's views are of interest. He says: "In the light of the recent discovery of the medical value of sunlight in tuberculosis conditions the question arises in my mind if the greatest aid in resisting tuberculosis by the native has not been largely removed by the forcing of clothes upon him. If I had my way I would strip every Pacific Islander down to a scanty covering and keep the bodies of all of them exposed to the healing rays of the sun until they acquired some resistance to tuberculosis. Possibly clothing is the worst curse of western civilization to them."

Dietary factors are also not without importance in relation to the tuberculosis problem in American Samoa, although not to the same degree as in some of the other island groups in the South Seas. Deficiency of vitamin A, according to Cilento, appears to have been common in the diets of Melanesians in New Guinea, and Strong, referring to his experience in Papua, was led to suspect that lack of vitamin A makes many native races susceptible to serious tuberculous infections. Cilento found in New Guinea that house boys who

were more closely in association with Europeans showed unexpectedly much less involvement with tuberculosis than plantation workers. He decided that the house boys were protected by their better diet, especially the fat element. Lambert believes diet must play the chief rôle in the increase of tuberculosis among plantation workers in New Guinea. He goes on to say that diet probably plays a chief rôle in island tuberculosis. "As natives associate with Europeans they learn to adore tinned fish and tinned meat and polished rice, biscuit, sugar, and tea. In many places where fish abound the fishing has come to be done by Japs or other races and the natives buy from them or no fishing is done. Where he is on a diet which is on the vitamin border line a little change in food sends him into the danger zone."

In most villages of American Samoa, barring disasters such as hurricanes, the native is probably quite safe so long as he adheres to Samoan food, providing chickens and pigs are raised in the usual numbers and fish are eaten from time to time. The vegetable foods available all the year round are taro, bananas, coconuts, and papaya. Breadfruit is plentiful during two principal breadfruit seasons, which last a few weeks each, and limited quantities are available at certain other times. The excellent physical condition of the majority of Samoan adults and children shows that these few articles, supplemented frequently with chicken, pork, and fish, constitute a good maintenance and growth promoting diet. To Americans such a restricted list of foods would be intolerable, and it is not surprising that Samoans are eager to procure tinned salmon, tinned corned beef, white flour, and refined sugar when they can. The native diet is rich in carbohydrates. Very little injudicious substitution with imported preserved articles of food can be practiced without bringing about a deficiency of fat soluble vitamin and of calcium. The typical diet, which is almost overbalanced with carbohydrates to begin with, will not stand the addition of white flour, polished rice, and refined sugar. Native Samoans do not drink milk and they do not eat eggs as a rule. Their protein intake is no doubt high enough in protein of good growth promoting value whether it be of animal or vegetable source.

So much for healthy Samoans. When we approach the tuberculosis problem the usual absence of milk from the diet is serious. Milk becomes almost necessary for its butterfat—vitamin A, calcium, and protein of high biological value. There are few cows in American Samoa. The butterfat content of their milk is 3 per cent at best and in most instances much less. Only a few natives who live in the western district can obtain fresh milk. Suitable food for cows is expensive and hard to obtain. It is not likely that the

production of cow's milk can be increased unless the tree bean, algaroba, which is used successfully in Hawaii, is introduced into American Samoa, where no doubt it could be cultivated satisfactorily and with little labor.

The breeding of milch goats is also a possibility worthy of consideration. In some respects goat's milk is safer, and some authorities consider it more valuable than cow's milk in the treatment of tuberculosis. Goat's milk is more quickly and directly transferred from producer to consumer than cow's milk. With the production of cow's milk for sale a serious public-health problem becomes inevitable; a problem that would be very difficult to handle without means for central pasteurization and adequate refrigeration from producer to consumer.

Meanwhile, the increasing use of powdered milk serves well as a substitute for fresh milk in cases where the natives can afford to purchase it and are willing to do so. Its use is gradually increasing. There is, however, no immediate prospect of its being used generally by Samoans, and tuberculosis subjects in particular are not likely to use this milk until they come under medical care. It, like fresh milk, becomes culture media when mixed with polluted water.

In American Samoa, with the Government taking cognizance of any tendency to shortage of native foods in any locality, diet probably plays an important rôle in the etiology of tuberculosis, chiefly among half-castes and those natives who live near the few stores where imported preserved foods are sold. The main reason why the incidence of tuberculosis is high and the death rate about three times as great as in the United States is frequent contact with sputum containing tubercle bacilli, the almost complete ignorance of the disease among most of the natives, and the present immunological status of Samoans in relation to that infection.

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#### ERRORS MADE IN PHYSICAL EXAMINATIONS AT RECRUITING STATIONS

By C. G. SMITH, Captain, Medical Corps, United States Navy

Physical examination of recruits is a most important duty, and medical officers charged with it should not view it lightly. As a matter of fact, the writer is of the opinion that the majority take this duty quite seriously, are capable, and seldom make mistakes through carelessness. However, a certain number of individuals, many, as the tables will show, whose defects could and should have been detected, are accepted as physically fit.

In this, the ninth naval district, recruits are comparatively easy to obtain; recruiting stations never have difficulty in obtaining their quota, and the recruiting officer as well as the medical officer may very well pick and choose those unquestionably physically fit from the total number of applicants.

The relative standing of recruiting stations in the ninth naval district for the year 1928, with regard to the number of recruits discharged from the service for various reasons, is as follows:

Recruiting station	Number of recruits received at Great Lakes	Medical discharges	Percentage	Standing	Other discharges	Percentage	Standing	Total recruits discharged	Percentage	Standing
Kansas City <sup>1</sup> .....	153	3	1.96	5	0	0	1	3	1.96	1
Des Moines.....	375	6	1.60	2	2	0.53	3	8	2.13	2
Louisville.....	246	3	1.22	1	4	1.62	4	7	2.84	3
Cincinnati.....	305	5	1.64	4	8	3.62	9	13	4.26	4
Milwaukee.....	274	4	1.62	3	7	2.53	7	11	4.45	5
Minneapolis.....	226	10	4.42	11	1	0.44	2	11	4.86	6
Detroit.....	412	16	3.88	8	9	2.18	5	25	6.06	7
St. Louis.....	408	12	2.93	6	13	3.74	10	25	6.12	8
Indianapolis.....	356	15	4.21	9	9	2.53	6	24	6.74	9
Chicago.....	446	14	3.16	7	20	4.46	11	34	7.62	10
Cleveland.....	456	20	4.38	10	15	3.28	8	35	7.66	11

<sup>1</sup> From Aug. 3, 1928, to Dec. 31, 1928.

Rear Admiral T. T. Craven, recently commandant of this district, wrote a report on recruiting which seems pertinent and informative:

Forwarded herewith are figures giving information with regard to discharges, for physical and other reasons, of recruits received from the recruiting stations indicated when under training at the Great Lakes Station.

The undesirability of enlisting recruits, transporting them, and fitting them out, all at considerable expense to the Government, and of then discharging them while under training, is manifest.

It will be noted that there is a very considerable discrepancy in the results, as observed at this place, of performances of different stations. Recruiting is an activity which is entirely human. Material considerations are not involved, and the measure of success is dependent entirely upon the intelligence, interest, and zeal exercised by recruiting parties, and particularly by those in charge of directing their efforts.

The greatest care should be exercised, in so far as practicable, to investigate the background of every recruit before he is accepted for the naval service. Medical officers should endeavor to create standards and observe practices which will obviate medical surveys at this place (or any other place) reflecting unfavorably upon the thoroughness of their work or upon the establishment of a common standard of physical requirements.

A study of the performances as indicated in the attached tables should supply officers charged with responsibility for obtaining naval recruits with the necessary information as to where improvement is possible. A closer attention to details which have resulted in discharges from this station, the

reservoir into which men are first passed, will result in a material diminution in the number of discharges, with a very considerable saving of expense to the Government.

Copies of this report were sent to all recruiting stations within the district and to the inspector of recruiting, central division.

That this, together with other follow-up methods, to be described later, has resulted in improved recruiting is manifest by a study of the following tables for the calendar year 1928 and the first six months of 1929:

Disability for which surveyed, Jan. 1, 1928, to Dec. 31, 1928	Cincinnati	Cleveland	Louisville	Detroit	Indianapolis	Chicago	Peoria	Milwaukee	St. Louis	Kansas City	Minneapolis	Des Moines	Nashville	Total
Enuresis.....	1	1	1	2	4	4	1	1	4	1	1			21
Caries, teeth.....		4		2	3	2		1	1		5	1	1	20
Gonococcus infection, urethra.....		1		3	1	2		1	1			1		12
Epilepsy.....		3			1	3	1		2		1			11
Otitis media, chronic.....		3		3	1	1		1			1			9
Constitutional psychopathic inferiority, without psychosis.....		2	1	2							1			6
Syphilis.....	1			1	1				2			1		6
Absence acquired, teeth.....	1	1			1	1								4
Malocclusion, teeth.....		1		1	1									3
Asthma.....									1			1		2
Flat foot.....		1					1							2
Hypermetropia.....					1				1					2
Ankylosis, right metacarp.....		1												1
Astigmatism.....					1									1
Constitutional psychopathic state, inad- equate personality.....										1				1
Constitutional psychopathic state, emo- tional instability.....				1										1
Deafness, unilateral, left ear.....												1		1
Defective physical development.....		1												1
Effort syndrome.....	1													1
Gonococcus infection, epididymis.....						1						1		1
Gonococcus infection, prostate, chronic.....														1
Hemorrhoids.....		1												1
Hernia.....										1				1
Pyorrhea, alveolaria.....							1							1
Stammering.....			1											1
Varicocele.....				1										1
Cicatrix, skin, right heel.....	1													1
Total.....	5	20	3	16	15	14	4	4	12	3	10	6	1	113

Disability for which surveyed, Jan. 1, 1929, to June 30, 1929	Buffalo	Chicago	Cincinnati	Cleveland	Detroit	Indianapolis	Louisville	Milwaukee	Minneapolis	Nashville	Pittsburgh	St. Louis	Total
Caries, teeth.....	5				1	1	2	1					9
Otitis media, chronic.....				1	1	2	1	1					6
Gonococcus infection, urethra.....		1	1						1				3
Absence, acquired, teeth.....				2									2
Epilepsy.....	1									1			2
Syphilis.....	1	1											2
Deafness, right ear.....	1												1
Defective physical development.....							1						1
Enuresis.....												1	1
Flat foot.....								1					1
Hernia, inguinal, right.....		1											1
Psoriasis.....													1
Total.....	9	3	1	3	2	3	4	2	1	1	0	1	30

*Total discharges, recruits, 1928*

Recruiting station	Medical survey	Inaptitude	Fraudulent enlistment, under age	Fraudulent enlistment, not under age	Undesirable	Bad conduct	Special order	Total
St. Louis.....	12	6	1	3	2	1	0	25
Cincinnati.....	5	2	2	0	2	0	2	13
Nashville.....	1	1	0	0	0	0	0	2
Detroit.....	16	4	1	0	2	1	1	25
Des Moines.....	6	2	0	0	0	0	0	8
Indianapolis.....	15	4	3	0	0	2	0	24
Minneapolis.....	10	1	0	0	0	0	0	11
Cleveland.....	20	3	0	0	1	0	1	25
Kansas City.....	3	0	0	0	0	0	0	3
Chicago.....	14	6	1	5	2	3	3	34
Louisville.....	3	0	1	0	0	1	2	7
Milwaukee.....	4	5	0	0	0	0	2	11
Peoria.....	4	0	1	1	0	4	2	12

The table for 1928 shows 113 discharges by reason of medical survey as compared with only 30 like discharges for the first six months of 1929. The latter shows a marked improvement and, if the ratio continues, the normal expectancy for those discharged by medical survey for 1929 should be approximately 60. This would show an increased efficiency of 46.51 per cent in recruiting.

An analysis of these tables shows that many, if not most, of the physical defects should have been detected at the time of enlistment.

Enuresis heads the list for individual causes of disability in 1928 and resulted in the separation from the service of 21 men soon after they were enlisted. This condition could not be detected at the time of enlistment if the recruit or his parents give an untruthful answer to the question regarding bed wetting. The latter statement may be made regarding epilepsy, with the exception, however, that the epileptic more frequently than not shows the stigmata of degeneration which should make the medical examiner hesitate even when the applicant has denied ever having had fits.

The apparent excessive number of recruits discharged for bed wetting, 21 in 1928, is possibly due to the intention on the part of some to "put it over" on the medical department of this station. What I mean to say is that a certain number of these lads become afflicted with nostalgia shortly after their arrival at the naval training station. Having no physical defects to use as a basis to secure a discharge and having heard that another recruit, a bona fide case, was discharged as a bed wetter, they deliberately urinate in their bedding.

At one time during 1928 bed wetting became almost an epidemic, but disciplinary measures, consisting of three or five days confinement on bread and water, were resorted to in connection with these deliberate cases and had a very salutary effect. This is evidenced

by the fact that during the first half of 1929 only one recruit was discharged from the service because of enuresis.

Dental defects combined were responsible for the discharge by medical survey of 27 men. The defects were as follows: Caries of teeth in 19 cases, absence of the required number of sound teeth in 4, malocclusion in 3, and pyorrhea in 1. In all cases resulting in discharge for these defects the men should never have been accepted at the recruiting station. The writer feels compelled to state as his opinion that medical examiners do not use sufficient care in the examination of the teeth. Let me here relate what has been observed at this training station frequently. Recruits are received with all the required teeth, but these teeth are carious and generally unsound. This condition had been detected by the medical officer, but he sends the applicant to a dentist or usually to some dental clinic where temporary fillings such as cement are hurriedly inserted and then the applicant is accepted as dentally fit, thus defeating the intent of the instructions as given in the Manual for the Medical Department. Carious teeth so filled, of course, do not meet the standard requirements and it is manifest that such practice is pernicious. Of course it is not expected, nor does the manual require, that all recruits shall be dentally perfect, but instructions in this connection should be adhered to rigidly, because, at best, less than 40 per cent of recruits received here can be made dentally fit for sea during the eight weeks' period of training.

Another procedure which seems to be a common practice may be referred to here. It is the endeavor and custom of most recruiting stations to obtain their quota early in the month, and after the quota is obtained to examine such applicants as may apply, who are then held over until the first of the following month. Perhaps there exists no reason to criticize this procedure, except that such recruits should be given a final physical examination to determine especially whether or not a venereal disease has developed since the original examination.

During 1928 it became necessary to discharge by medical survey 12 men with acute gonorrhoea, all of whom stated that they developed the disease between the time of the physical examination and their final acceptance at the recruiting station.

Applicants with defective vision, deafness, chronic middle-ear disease, flat feet, and other manifest defects would never be accepted if the medical officer on recruiting duty makes a conscientious examination.

Whenever a recruit is discharged by reason of medical survey a copy of the report of survey is sent to the medical officer concerned for his information. The commandant also writes a letter



to the officer in charge of the particular station, an example of which is as follows:

1. The subject-named man, a recruit enlisted at the station under your command, has this date been discharged from the naval service on account of medical survey. The diagnosis of the Board of Medical Survey in this case was "Syphilis" and the following findings are quoted:

"Physical examination on arrival at this station revealed a large indurated sore on scrotum and generalized adenopathy. Kahn test 4 plus. Patient states the sore was present at the time of examination at the recruiting station. Condition existed prior to enlistment. Medical treatment prior to discharge not advisable. Article 1196, United States Navy Regulations, 1920, complied with. Statement attached."

2. It is the opinion of the commandant that the condition of this man, which resulted in his discharge, should have been detected by the medical officer or the recruiting officer, and an explanation of his acceptance is desired.

The following reply by indorsement was received from the medical officer:

1. Returned. A small pustule was noted on the scrotum of the subject-named man at the time of his examination for enlistment.

2. There was present no lesion which remotely suggested syphilis at that time.

3. If the lesion had presented the same appearance as described in the medical survey a dark-field examination for the spirochetes of syphilis would have been indicated and would have been made at one of the free clinics in the city. However, a small pustule of ordinary type, such as this was, does not indicate further examination, and also it is not possible to make a Wassermann and Kahn tests on all applicants for enlistment.

A letter such as the following is occasionally found to be necessary:

1. The subject-named man, a recruit, enlisted at the station under your command, has this date been discharged from the naval service on account of medical survey. The diagnosis of the Board of Medical Survey in this case was "Otitis media, chronic," and the following findings are quoted:

"Physical examination on arrival at this station revealed a small perforation of right ear drum lower posterior quadrant. Upper posterior quadrant covered by calcareous deposit. Drum membrane generally inflamed and small amount of pus exuding through perforation. Hearing is only slightly impaired. No history of earache or running of the ear at any time. Medical treatment prior to discharge not advisable. Article 1196, United States Navy Regulations, 1920, complied with. Statement attached."

2. It is the opinion of the commandant that the condition of this man, which resulted in his discharge, should have been detected by the medical officer or the recruiting officer, and an explanation of his acceptance is desired.

The following reply by indorsement was received from the medical officer:

1. When the subject-named man was examined for enlistment the small perforation of right ear drum was noted by the undersigned. The calcareous deposit was noted. In view of the fact that the candidate heard the whispered

voice distinctly at 15 feet and there was no history of earache or running of the ear at any time during his life, and being otherwise desirable, he was recommended for enlistment in the Navy.

The commandant answered the reply made by the medical officer in this case as follows:

1. The commandant is of the opinion that more care should be used in examining recruits for enlistment, particularly to detect the existence of chronic ear disease.

2. When a recruit with a chronic ear disease is accepted he is from the start physically unfit for two important duties in the service, namely, aviation and submarine duty, beside which, if he has a foul discharge from the ear, which is usually incurable, he is for that reason a most undesirable shipmate in any situation.

The reactions of recruiting officers and medical officers to such communications vary, but as a rule the error is admitted and regret expressed. Some replies, however, are resentful in tone and the explanation is usually either ludicrous or facetious.

It is never the purpose of these letters to cause humiliation, embarrassment, or a feeling of resentment because the judgment of the medical examiner is questioned. Their sole purpose is to point out mistakes so that they may not recur and thus in general improve recruiting.

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#### REVIEW OF REPORTS SUBMITTED BY MEDICAL OFFICERS REGARDING FULL-POWER TRIALS, 1928-29

The Rules for Engineering Performances 1928-29 require certain data in the medical officer's report, which, it is stated, will be attached to the engineer officer's report. Included in these data are the temperature and relative humidity of the air at points representative of conditions actually experienced by men at work in (a) engine rooms, (b) firerooms, (c) coal bunkers—(1) at the beginning of the full-power trial, (2) at the height of the trial or time when the greatest degree of overheating is experienced, and (3) as the trial is coming to an end.

A review of reports submitted by medical officers regarding the conditions observed on board 11 vessels of the battleship class and 71 vessels of the destroyer class indicate that, in general, ventilation was satisfactory in all locations where men were at work. The air was found to be in sufficient motion to facilitate evaporation of perspiration and to promote maximum comfort consistent with recorded temperatures and humidity.

On board a number of vessels the highest temperatures in the firerooms were experienced at the beginning of the trial, at which

time the air was found to be comparatively dry. The increased speed of the blowers lowered these temperatures considerably during the run. On the other hand, the highest temperatures in the engine rooms were noted near the completion of the trial, when the humidity was greater on account of escaping steam. Several reports stated that the men suffered less discomfort than under conditions existing during ordinary cruising. The medical officer of the U. S. S. *Arizona* observed that while conditions in a full-power trial in the Tropics might cause some physical discomfort, an oil-burning installation of the type installed seems to present no problems to the Medical Department when the ship is operating in a temperate climate. The medical officer of the U. S. S. *California* stated that unfavorable conditions noted in previous reports of full-power trials apparently have been overcome as a result of minor changes in the supply and exhaust ventilation systems recently made during overhaul. Poor ventilation of the steam steering engine room was reported by the medical officer of the U. S. S. *Mississippi*, who recommended an increased supply to this compartment and the installation of exhaust ventilation.

Reports from 2 battleships and 21 destroyers contained only the dry-bulb temperatures. In most of these instances no apparatus was available for determining the relative humidity. For the second consecutive time the report from one of the battleships gave the dry-bulb temperatures and barometric readings taken in the various compartments and stated that relative humidity of machinery spaces and firerooms was not recorded due to the fact that neither a sling psychrometer nor a sufficient number of wet and dry thermometers were available for taking data. Wet and dry bulb readings, together with relative humidity estimations, which are essential for the proper interpretation of conditions existing during the trials, consequently were not recorded.

The differences in atmospheric pressure in different parts of the ship would, of course, be so inappreciable as to have no relation to the health of the personnel. It is well known that greatly reduced or increased air pressures cause mountain sickness or caisson disease, respectively, while minor variations have no evident physiological effects. In the above instance greatly reduced pressures may be dismissed from consideration. On the other hand, the only artificial air pressure normally present in the various compartments of a battleship is that maintained in the firerooms by blowers. This is usually equivalent to a column of 4 to 6 inches of water, which is clearly insufficient to produce caisson disease.

The Bureau of Navigation supplies two psychrometers to each battleship or other capital ship and one to each small ship. It is considered that these are available for use in collecting the data required in the report regarding atmospheric temperature, relative humidity, air movement, and physical efficiency of the personnel in firerooms and engine rooms during engineering trials and full-power runs. Medical officers and Hospital Corps men on independent duty aboard the smaller ships should, therefore, anticipate the requirements of full-power trials and not only ascertain beforehand that the necessary apparatus is on board but also that it is in good working order.

In cases where the dry-bulb temperature is very high a relative-humidity table showing values for temperatures as high as the observed temperature may not be available. In such instances the wet-bulb and dry-bulb readings as observed will suffice. The percentage of water vapor present will be calculated in the bureau, but, when practicable, the calculations should be made on board ship. Correct data should be incorporated in full-power trial reports for their proper interpretation, as these reports are thoughtfully reviewed in the Bureau of Medicine and Surgery.

No poisonous fumes or gases were noted. In one instance the odor of grease and burning oil was present and noticeable, but not to the extent of being unpleasant or detrimental to physical effort. The report from the U. S. S. *Cochlan* stated that a strong odor of gases from the stacks was carried into the engine rooms by the blowers. This was promptly corrected, however, by a change of "course."

Conditions on board the U. S. S. *Osborne* were reported by the engineer officer due to the fact that neither a medical officer nor a pharmacist's mate was on board. He stated that at the conclusion of the full-power trial watch standers showed signs of physical exhaustion. "This condition was caused by the high temperatures which prevailed during the run due to lack of sufficient insulation on the furnace fronts. The outside temperature during the trial averaged 77° F., the firerooms 140° F., and the engine room 130° F." In this connection it is interesting to note the following comment on the report for the preceding year. The U. S. S. *Osborne*, with a fireroom temperature of 140° F., engine room 130° F., and outside air 80.5° F., reported that at the conclusion of the full-power trial the men standing watch in the firerooms showed signs of physical exhaustion on account of the high temperatures, but no unfavorable comment was made regarding the engine rooms where a higher

relative humidity is to be expected and where conditions should have been worse.

A case of heat cramps described as a "very slight attack" occurred on board the U. S. S. *Dale*. The temperatures were: Outside air, 78° F.; humidity, 68 per cent; engine rooms, 102° F., humidity not given; and firerooms, 103° F., humidity not given. It was stated that ventilation was sufficient. The men appeared physically qualified to perform all the duties required during the run and showed excellent endurance.

An engineman on watch in the after engine room on board the U. S. S. *Charles Ausburn*, who seemed to be in a dazed condition, was relieved from duty. He admitted that he had not felt well during the two weeks preceding the trial. The conditions in the engine room were not regarded as the direct cause of his illness.

A case of heat exhaustion, which necessitated the man's relief from duty and removal from the engine room, occurred on board the U. S. S. *William B. Preston*. No other cases of discomfort or fatigue were noted. According to the report, the ventilation of the engine and firerooms was excellent. "The temperatures of the engine and firerooms were only slightly above the ordinary cruising conditions, with no apparent change in the humidity." Apparently the wet and dry bulb temperatures were not taken.

The highest recorded temperatures during the trials were reported by the U. S. S. *Williamson*. "The temperature of the outside air at the beginning of the trial was 87° F.; at the height, 87° F.; and at the end, 85° F. The temperature of the air in the working spaces of the engine rooms averaged 110° F. throughout the trial. At the beginning of the trial it was 102.2° F.; at the height, 120° F.; and at the end, 115° F. The temperature in the working spaces of the firerooms on the floor plates was (a) at the beginning of the trial, 150° F.; (b) at the height, 180° F.; (c) at the end, 180° F. The average on the gratings was 170° F. No apparatus was available for testing the relative humidity of the air in either engine rooms or firerooms." The above temperatures recorded in the firerooms would indicate intolerable conditions for continuous effort were it not for the fact that the observer stated that the men in both engine rooms and firerooms were physically well qualified to perform their work during the trial. "There were no ill effects on the personnel noted from any cause during the trial." The nearest approach to these temperatures was 140° F. reported in the firerooms of the U. S. S. *Osborne*, a vessel of the same class. It is therefore believed that the temperatures as recorded were in error. Provided the con-

ditions are as reported, radical changes in the ventilation of the firerooms of the U. S. S. *Williamson* are urgently required.

Commander C. B. Camerer, Medical Corps, United States Navy, attached to the U. S. S. *West Virginia*, made some interesting observations during the full-power trial which was held off the coast of California while the ship was en route from Bremerton, Wash., to San Pedro, Calif. The trial started at 7 a. m. and was completed at 11 a. m. on September 2, 1928. He recorded before and after the run the blood pressure, temperature, pulse, and respiration of 3 men on duty in fireroom No. 3, 3 in fireroom No. 8, and 11 in the machinery spaces. These readings were taken immediately prior to their going on watch and in the compartments under active working conditions just before they were relieved at the expiration of their watch. The age of the men observed, who represented a fair random sampling of those working in the various spaces, averaged 22 years. Both firerooms and the machinery spaces under observation are spacious and well ventilated.

The following tables show the atmospheric conditions prevailing in these spaces during the trial:

TABLE 1

Hour	Fireroom No. 3				Fireroom No. 8			
	Air pressure <sup>1</sup>	Dry bulb	Wet bulb	Relative humidity	Air pressure <sup>1</sup>	Dry bulb	Wet bulb	Relative humidity
8 a. m. ....	5.5	97	78.0	38.1	6.0	99.3	71	22.0
9 a. m. ....	5.5	97	78.3	38.1	6.0	96.0	77	37.3
10 a. m. ....	5.5	96	77.0	36.3	6.2	95.0	76	38.3
11 a. m. ....	5.6	100	73.0	30.1	6.3	97.0	78	38.1

<sup>1</sup> Air pressure equivalent to inches of water.

TABLE 2

Hour	After machinery space			Outside air			
	Dry bulb	Wet bulb	Relative humidity	Barometric pressure	Dry bulb	Wet bulb	Relative humidity
8 a. m. ....	95.0	76.5	38.0	30.2	58	58	100
9 a. m. ....	96.0	77.0	37.3	30.2	58	57	93
10 a. m. ....	95.5	76.5	37.1	30.2	56	55	93
11 a. m. ....	96.0	76.5	35.1	30.2	57	57	100

The blood pressure, pulse, temperature, and respiration of each man were recorded as follows:

TABLE 3.—Blood pressure of personnel before and after 4-hour trial

	Systolic				Diastolic				Pulse pressure			
	Before	After	Increase	Decrease	Before	After	Increase	Decrease	Before	After	Increase	Decrease
<i>Fireroom No. 3</i>												
Water tender, second class.....	100	118	18	---	70	72	2	---	30	46	16	---
Fireman, second class.....	102	118	16	---	70	80	10	---	32	38	6	---
Fireman, first class.....	100	120	20	---	68	82	14	---	32	38	6	---
<i>Fireroom No. 8</i>												
Water tender, first class.....	118	128	10	---	72	80	8	---	46	48	2	---
Fireman, second class.....	118	130	12	---	78	80	2	---	40	50	10	---
Fireman, third class.....	120	120	---	---	80	78	---	---	40	42	2	---
<i>Machinery space</i>												
Electrician's mate, first class.....	120	118	---	2	80	78	---	2	40	40	---	---
Electrician's mate, third class.....	108	110	2	---	78	78	---	---	30	32	2	---
Fireman, second class.....	116	122	6	---	78	78	---	---	38	44	6	---
Engineman, first class.....	118	122	4	---	76	80	4	---	42	42	---	---
Electrician's mate, first class.....	98	110	12	---	60	70	10	---	38	40	2	---
Engineman, second class.....	116	120	4	---	72	78	6	---	44	42	---	2
Machinist's mate, first class.....	118	122	4	---	82	80	---	2	36	42	6	---
Fireman, third class.....	102	116	14	---	68	78	10	---	34	38	4	---
Machinist's mate, first class.....	118	120	2	---	82	78	---	4	36	42	6	---
Do.....	118	120	2	---	80	78	---	2	38	42	4	---
Fireman, second class.....	128	138	10	---	70	72	2	---	58	66	8	---

TABLE 4.—Temperature, pulse, and respiration of personnel before and after

	Temperature				Pulse				Respiration			
	Before	After	Increase	Decrease	Before	After	Increase	Decrease	Before	After	Increase	Decrease
<i>Fireroom No. 3</i>												
Water tender, second class.....	97.8	98.4	0.6	---	68	80	12	---	18	18	---	---
Fireman, second class.....	98.6	98.6	---	---	80	78	---	2	16	18	2	---
Fireman, first class.....	97.0	98.6	1.6	---	86	86	---	---	18	20	2	---
<i>Fireroom No. 8</i>												
Water tender, first class.....	97.4	99.0	1.6	---	74	88	14	---	20	20	---	---
Fireman, second class.....	97.0	98.6	1.6	---	68	72	4	---	20	22	2	---
Fireman, third class.....	97.0	99.0	2.0	---	68	84	16	---	17	20	3	---
<i>Machinery space</i>												
Electrician's mate, first class.....	97.4	98.2	.8	---	78	78	---	---	18	18	---	---
Electrician's mate, third class.....	97.0	98.0	1.0	---	64	76	12	---	18	20	2	---
Fireman, second class.....	97.0	98.6	1.6	---	76	92	16	---	18	22	4	---
Engineman, first class.....	97.0	98.2	1.2	---	72	84	12	---	18	18	---	---
Electrician's mate, first class.....	97.0	99.0	2.0	---	72	76	4	---	20	20	---	---
Engineman, second class.....	98.0	98.8	.8	---	78	86	8	---	22	18	---	4
Machinist's mate, first class.....	97.0	98.7	1.7	---	72	76	4	---	19	21	3	---
Fireman, third class.....	97.4	98.2	.8	---	78	74	---	4	20	18	---	2
Machinist's mate, first class.....	97.0	97.8	.8	---	96	96	---	---	15	18	3	---
Do.....	97.3	98.0	.7	---	72	68	---	4	14	16	2	---
Fireman, second class.....	97.0	98.2	1.2	---	74	92	18	---	18	20	2	---

Doctor Camerer stated that "No evidence could be adduced tending to show undue physical stress beyond that normally found after ordinary physical exertion for the same period of time. The personnel concerned present a picture of average healthy adults. No complaints were elicited by questioning, and the effects apparently were no greater than observed following ordinary steaming watches; in fact, not as great as usually noted following routine turns of duty in tropical waters. The temperature and humidity recorded on board this vessel were not regarded as high, weather conditions duly considered, and no deleterious effects relative thereto were observed."

The men of this particular group who have been performing these same duties in like spaces over a period which possibly would average three and one-half years have body temperatures and blood pressures that were considered by Doctor Camerer as below normal.

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**A FATAL CASE OF TOXIC CIRRHOSIS OF THE LIVER FOLLOWING THE ADMINISTRATION OF NEOARSPHENAMINE**

A death from acute toxic cirrhosis of the liver occurred on September 25, 1929, or 44 days after the fourth injection of neoarsphenamine had been administered during the third course of treatment for a luetic infection.

The patient, a private of the Marine Corps, was 21 years of age at the time of his death. When he first enlisted in the above organization on August 5, 1927, his height was recorded as 69 inches and his weight 142 pounds. Entries in his health record described his early development as normal. At 12 or 15 years of age he had an attack of diphtheria and at 13 his tonsils and adenoids were removed. He smoked two or three cigarettes a day, but had not indulged in alcoholic beverages during the year before the onset of his final illness, although prior to that he had taken a drink at occasional intervals. He denied the use of drugs.

On May 2, 1928, a blood Kahn reaction performed at a naval hospital was reported as 4 plus. The patient at this time gave a history of a lesion on his tongue one month before and complained of a "sore throat." A physical examination revealed numerous mucous patches in the mouth and throat and an abrasion of the upper lip. It was believed that these lesions were contracted innocently. He was transferred to hospital the following day, where a dark-field examination of material from the lesions in the throat was negative for the *Treponema pallidum*, and he was discharged to duty May 12, 1928, after nine days' treatment. While a hospital patient he received two injections of neoarsphenamine, amount not stated,



potassium iodide internally, and daily inunctions of mercury. Beginning May 16, weekly injections of neoarsphenamine 0.6 gm. each and daily inunctions were given until June 12, when he had received a total of five injections or 3 gm., and 27 inunctions. On August 6, 1928, the blood Kahn reaction was reported as single plus. During the period September 4 to October 23, 1928, he received one injection of neoarsphenamine, 0.45 gm., and six, 0.6 gm., or a total of 4.05 gm., together with 42 inunctions. Negative blood Kahn reactions were recorded on November 26, 1928, March 18, and April 22, 1929. He was transferred to a battleship about June 19, where the third course of treatment was started on July 1, 1929. He was on the sick list for an intercurrent acute catarrhal fever from July 25 to July 29. Jaundice, associated with anorexia, malaise, and epigastric pain, became apparent on August 19, after four injections of neoarsphenamine, amount not stated, and 10 inunctions had been given. Antileptic treatment was then discontinued. He immediately became a bed patient, was placed upon a high fluid intake, a high carbohydrate diet, and given daily doses of magnesium sulphate. The urine was dark in color and tests for bile pigments were strongly positive. The stools were described as being light in color. It was believed that neither the luetic infection nor the anti-luetic treatment had any direct bearing upon his present illness, and sodium thiosulphate was apparently not administered. Slight improvement had occurred when he was transferred to hospital 11 days later.

A physical examination after transfer disclosed a deeply jaundiced patient, who appeared acutely ill. The skin over the entire body and the sclerae were of a deep lemon color. He weighed 141 pounds and, according to his history, had lost 30 pounds during the past month. There was a generalized adenopathy, including both epitrochlear lymph nodes. The heart was apparently normal, rate 48, blood pressure 110/60. The liver was enlarged, extending one finger's breadth below the costal margin. There was slight tenderness in the epigastrium and over the region of the gall bladder, but no rigidity was present. Urinalysis showed a slight trace of albumin, a moderate number of leukocytes, and a few cylindroid, hyaline, and finely granular casts. All casts and leukocytes were bile stained. Gall-bladder drainage was performed September 1. Duodenal contents showed a small amount of blood. Bile was not evident, though chemical tests were positive. A blood examination several days later showed 5,050 white blood cells, hemoglobin 85 per cent, and a differential count within normal limits. The blood icterus index varied from 209 to 230, the latter on September 14, when an immediate direct van den Bergh reaction and a positive indirect Stangley reaction were recorded in the health record.

He was transferred from the medical to the surgical service, where an exploratory laparotomy was performed under spinal anesthesia two days later. While it was recognized that the patient's jaundice and associated symptoms developed shortly after the administration of neoarsphenamine, the negative Kahn test, the immediate direct van den Bergh reaction, the icterus index, and the aggravation of symptoms were considered evidence sufficient to indicate an exploratory laparotomy in order to ascertain the cause of the intense jaundice. In this connection O'Leary, Greene, and Rountree (1) of the Mayo Clinic state: "The complications that develop in the liver during or shortly after a course of antisyphilitic treatment are disturbing and may be serious. There has been considerable discussion as to whether these reactions, particularly the jaundice, were the result of the toxic effects of arsphenamine, of mercury and iodides, or of a secondary infectious agent. Possibly, too, a liver injured by syphilis or arsphenamine may be unduly susceptible to the effect of the minor infections of everyday life. Without attempting to assume a strongly partisan attitude, we have been impressed with the fact that any of these factors may be at fault and that, in addition to the syphilis, some irrelevant entity, such as cholelithiasis, or carcinoma in the biliary system or adjacent viscera, may be the cause of jaundice in a patient recently treated for syphilis. O'Leary (2) emphasized the fact that the appearance of jaundice in a patient in whom a series of injections of arsphenamine or mercury has recently been completed, presents a problem of differential diagnosis which at times may require a long period of observation before definite conclusions are possible. Inadequate knowledge of the syndrome of early hepatic disease in general, with the inadequacy of the laboratory methods available at this time, and the fact that various factors will produce the same clinical syndrome, are the reasons for the present confusion in regard to this complication of jaundice. As is readily realized, the severity of the symptoms of this complication, for convenience called post-arsphenamine jaundice, is dependent on the degree of injury to the liver, whether from arsenic, mercury, staphylococci, streptococci, or syphilis." At operation the pyloric lymph nodes were found to be very much enlarged. There was a marked hepatitis. While the gall bladder was dilated the walls were apparently normal and no gallstones were discovered. Drainage of the gall bladder was established. Following operation, the patient was given glucose solution by proctoclysis and later a solution of bicarbonate of soda and glucose intravenously with insulin. Although there was free drainage of bile the icterus index rose to 300, and the patient became increasingly toxic. Coma preceded death, which occurred 7

days after operation and 44 days after the last injection of neoarsphenamine.

The necropsy report, as given in the health record, is as follows:

1. *General*.—Body of white male about 21 years of age. Rigor mortis is not manifest. Moderate emaciation. Entire body deeply jaundiced. Recent gall-bladder incision with dressings and drainage tube in place.

2. *Chest*.—(a) Heart: Left ventricle contracted; right ventricle and auricle dilated and filled with blood; heart and pericardium apparently normal; aorta suggestive of early syphilitic aortitis. (b) Lungs: Normal, except for congestion of posterior aspects.

3. *Abdomen*.—(a) Large hematoma in abdominal wall adjacent to gall-bladder incision; blood clot in upper right quadrant posteriorly; about 1,200 c. c. of fresh fluid blood in abdominal cavity; all abdominal organs are jaundiced. (b) The liver is very small, firm, of a dark grayish-green color, and nodular; there are several large nodules elevated above the general contour and numerous small nodules along the antero-inferior border; on section nearly the entire liver is abnormal, being of a dark grayish-green color and showing only small areas which appear normal; the liver in the gall-bladder region approaches normal; the nodular areas are harder than the surrounding liver substance; weight, 1,075 gm.; there is an enlarged gland pressing on the common duct. (c) Spleen: Enlarged, due to passive congestion. (d) Kidneys: Slightly enlarged, congested, and of a dark, slightly greenish appearance. (e) Pancreas: Normal. (f) Stomach-intestines: Mucosa of stomach deeply congested (passive congestion) with ecchymosis; a few ecchymotic patches beneath serosa of small intestines and also on mesentery.

4. *Pathologic histology*.—(a) Liver: Marked destruction of liver cells, with moderate fibrosis mostly of central type (central necrosis); considerable pigmentation. (b) Kidneys: Passive congestion, with some swelling of the tubular epithelium; sections of lung, heart, aorta, spleen, pancreas, and duodenal lymph-node show nothing characteristic.

The liver was sent to the laboratory of the United States Naval Medical School, Washington, D. C., for further examination, the results of which are as follows:

*Gross examination*.—Specimen consists of a liver which has been sectioned. It is small and round. Surfaces are irregular and some areas coarsely nodular. The nodular areas are greenish in color. Smooth portions are dirty brown. On section about three-fourths of the tissue is represented by the greenish nodular masses in which distorted lobular markings can be seen. In the brownish areas the lobular markings have disappeared. The gall-bladder wall is somewhat thickened, and the mucosa appears normal.

*Chemical examination*.—After treatment to convert organic arsenic into the inorganic form, a portion of liver tissue revealed, by the modified Gutzeit method, the presence of 0.002 per cent of arsenic as metallic arsenic.

*Microscopical*.—Sections show wide areas in which complete destruction of liver cells has occurred. These areas are composed of the necrotic debris of the liver cells, fibrous reticulum, congested capillaries, and numerous bile ducts which have apparently undergone proliferation. This portion of the tissue gives an intense fat stain. This is the smooth brownish portion of the gross specimen. Section through the bile stained nodular portions of the gross specimen shows regenerated liver cells, with considerable bile pigment deposition and some albuminous and fatty degeneration of the polygonal cells.

While the amount of antiluetic treatment accorded this patient can hardly be considered excessive, his death may be ascribed primarily to acute poisoning by neoarsphenamine due to retention of the drug in the liver which caused massive destruction of liver tissue.

#### REFERENCES

- (1) O'Leary, Paul A., Greene, Carl H., and Rowntree, Leonard G. The Various Types of Syphilis of the Liver with Reference to Tests for Hepatic Function. *Archives of Internal Medicine*, August, 1929.
- (2) O'Leary, P. A. Postarsphenamine Jaundice. *Mayo Clinic of North America*, 8:1203, 1925.

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#### A SMALL OUTBREAK OF FOOD POISONING AT OCOTAL, NICARAGUA

A small outbreak of food poisoning occurred on January 28, 1929, among members of the Eleventh Regiment United States Marine Corps stationed at Ocotal, Nicaragua. The outbreak was reported by Lieut. C. N. Smith, Medical Corps, United States Navy.

Canned corned beef made into hash in a semipermanent field kitchen and served for breakfast on the morning of January 28, 1929, was the suspected food. All of the 18 men who became ill had eaten hash served from one pan, while of 9 others who received a portion of hash from this pan, 8 refrained from eating it, asserting that it did not smell right or that it did not taste right. The remaining man ate a small quantity and complained during the afternoon of a headache and stated that his "stomach felt heavy." He fed some of the hash to a 2-month-old puppy, which displayed no ill effects. Of those affected, all recovered, 16 after one day on the sick list, while 2 required treatment for two days. Men who were served the same food but which was obtained from other pans were not affected.

The evening meal of the preceding day consisted of potato salad, minced corned beef, baked beans, bread, jam, and coffee. Four of the men who showed symptoms of food poisoning had not partaken of this meal. Corned-beef hash, boiled eggs, corn-meal mush, pineapple, bread, butter, and coffee were served for breakfast the day of the outbreak.

First symptoms occurred between three and a half to four hours after breakfast. The onset of symptoms was sudden. All patients had intense nausea, vomiting, cramps without abdominal distention, and intense thirst. All patients experienced varying degrees of prostration. Three showed evidence of shock and of these one presented considerable cyanosis of the face and hands. Neither headache, efflorescence, nor fever were noted in any case. Most patients had chilly sensations and four had distinct chills. Several

patients complained of backache and four had muscular cramps in the arms and legs. No excessive salivation was noted and no patient complained of a bitter taste. The pupils were dilated, but other ocular symptoms were not observed. The pulse rate was uniformly rapid. Circulatory stimulation was required in three cases. Blood pressure was not taken. Two patients raised thin frothy blood-tinged sputum. Respiration was rapid in most cases and shallow in a few. There were no facilities for making toxicological or bacteriological examinations. Blood counts were not made.

The corned beef in question had been obtained on requisition from the quartermaster and stored in Ocotol for a period of about 11 months. It is not known when the meat was packed, but December, 1926, or February, 1927, were the dates stamped on the remaining boxes containing this issue. Investigation showed that the hash had been freshly prepared on the morning of January 28 and that not more than 45 minutes had elapsed from the time it was removed from the oven until it was served. In preparing the hash three cans of corned beef, none of which showed evidence of spoilage of can or contents, were opened about 4.30 a. m. The meat was emptied onto a table where it was cut into small pieces. It was placed in large baking pans and mixed with fresh potatoes, fresh onions, canned peas, and tomatoes. The vegetables were in good condition and were cooked before the cans of meat were opened. The pans containing this mixture were put in the oven at 4.45 a. m., the hash baked for about 60 minutes and then kept warm until 6.30 a. m., when it was served with catsup spread over the top as an appetizer.

Breakfast was served at three different times, and this required the preparation of three or four pans of hash. All of the men attacked received their ration of this article of diet from the third pan.

It is believed that no change occurred in the meat from the time the cans were opened until the hash was served, but that one of the cans contained contaminated meat which happened to be used in making the third pan of hash. There was no noticeable change in the appearance, taste, or odor of the meat to indicate contamination.

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**REPORT OF A SMALL OUTBREAK OF FOOD POISONING ON BOARD THE  
U. S. S. "PATOKA" ATTRIBUTED TO CRAWFISH**

By H. B. LAFAVRE, Lieutenant Commander, Medical Corps, United States Navy

A small outbreak of food poisoning occurred on board the U. S. S. *Patoka* at Key West, Fla. The suspected food was crawfish which had been purchased in the local markets and served in the ward-room mess as part of the noon meal on November 8, 1929. Other members of the crew who became affected had eaten crawfish at

various restaurants in the city. The crew consisted of approximately 158 men, 12 of whom exhibited symptoms of food poisoning. Admission to the sick list was required in but one case.

The fish served in the officers' mess, in so far as it could be learned by questioning those who were responsible for the care and preparation of the food, had been cooked shortly after they were caught and were then placed in the cold-storage space, where they remained overnight. An inspection of the fish by the medical officer when they were brought on board showed that they were apparently in excellent condition. There was nothing in the appearance, odor, or, later when they were eaten, in the taste to indicate that any putrefactive or other noticeable change had taken place.

An observation, considered important, was that regardless of the source from which obtained, almost everyone who gave a history of having eaten crawfish on the date mentioned above became ill. One of the officers ate the fish in a private home, while several of the men ate them in restaurants located in sections of the town widely separated from each other. Fish served in the officers' mess were purchased from a vendor, while the captain's steward secured his supply at the down-town market. Thus, it would appear that the entire catch of crawfish for that day had become infected with some member of the paratyphoid-enteritidis group of microorganisms and that this contamination was not limited to any single portion of the catch.

Indications of food poisoning appeared in from 18 to 24 hours following the ingestion of the suspected food, except in two cases. The patient in one of the latter two cases was attacked at the expiration of 48 hours, while in the other case the patient was admitted to the sick list on the fourth day with very pronounced symptoms. This man stated that he had been "a little upset" during the previous two days, but that he had not considered his condition serious. As a matter of fact, this case proved to be the most severe of all.

The clinical symptoms, which in general were mild, consisted of abdominal cramps, diarrhea, slight elevation of body temperature, headache, increased pulse rate, diminished pulse pressure, neuritic pains extending down the legs, general muscular weakness, and nausea.

All symptoms subsided rapidly after eliminative treatment was administered and in nearly all instances the patients recovered in about 24 hours. There were no sequelae.

No bacteriological examination was possible due to the lack of equipment. The exact character of the causative microorganism is therefore unknown, but the symptomatology and incubation period would seem to suggest an infection by a member of the Gärtner group of microorganism.

## HEALTH OF THE NAVY

Based on returns for diseases and injuries occurring in July, August, and September, 1929, the general admission rate was 585 per 1,000 per annum, as compared with 551, the rate for the preceding quarter. The rate for the third quarter of 1928 was 641. The median rate for the third quarter of the preceding five years is 540.

The admission rate from disease was 505 per 1,000 per annum, as compared with 470, the median rate for the corresponding three months of the five preceding years. The admission rate from accidental injuries was 75 per 1,000 per annum. The median rate for the five-year period, 1924-1928, third quarter, is 65.

Acute infections of the respiratory type exceeded expectancy at the United States naval training station, Great Lakes, Ill. There were 84 cases of catarrhal fever in July, 97 in August, and 93 in September. This increase was attributed by the senior medical officer to the practice of admitting all recognized cases of this disease, however mild, to the sick list for treatment.

The United States naval training station, San Diego, Calif., reported no case of scarlet fever for the quarter. A small outbreak of this disease occurred during the months March to June, inclusive. There were 45 cases of catarrhal fever reported by this station in July, 72 in August, and 80 in September. German measles was present to the extent of 6 cases in July and 3 in August. Seventeen cases of mumps were reported in September. A draft of men was received on June 30, 1929, from the United States naval training station, Newport, R. I. The men who had been placed in quarantine on board ship because of an outbreak of cerebrospinal fever were released during the month of July. No case of this disease developed after they arrived. Two patients were transferred to hospital from this station with symptoms suggestive of cerebrospinal fever. Both cases proved negative.

Health conditions at the United States naval training station, Hampton Roads, Va., continue to be excellent. Leave to visit Roanoke, Va., was denied station personnel during the month of August because of the prevalence in that vicinity of acute anterior poliomyelitis. All recruits and other men received from that section were placed under observation for a period of three weeks after arrival.

No case of cerebrospinal fever was reported by shore stations during the quarter. A recruit from the United States naval training station, San Diego, Calif., however, became ill with cerebrospinal fever while on leave and was transferred to a civil hospital, where he died about 10 days after the onset of symptoms.

An epidemic of smallpox among the civilian population of Panama started in June, 1929. Up to September 30, 276 cases had been reported. In three instances the patients were canal employees. All naval personnel serving in Panama who required the procedure were revaccinated. A successful vaccination within the last 12 months is required of personnel on board naval vessels before they are permitted liberty. No case of smallpox was reported by ships or shore stations during the quarter.

The admission rate, all causes, for forces afloat was 498 per 1,000 per annum. The median for the third quarter of the preceding five years is 454.

In general, excellent health conditions were indicated by reports and returns from forces afloat. There were 175 cases of catarrhal fever reported by all ships in July, 205 in August, and 197 in September. The U. S. S. *Tennessee* reported 19 cases of measles in July and the U. S. S. *Mississippi* 7 cases in August and 1 in September. Three fatal cases of cerebrospinal fever developed among forces afloat in July—1 on board the U. S. S. *Altair* and 1 on board the U. S. S. *West Virginia*, of the Battle Fleet, and the third on board the U. S. S. *Avocet*, of the Asiatic Fleet. In a fourth case a patient developed cerebrospinal fever June 21, three days after he was transferred to hospital from the U. S. S. *Vestal*. On July 5, while seemingly convalescent, symptoms of intestinal obstruction appeared. Death occurred two hours after an immediate exploratory laparotomy was performed. The U. S. S. *Wood* reported one case of diphtheria in August. The U. S. S. *Sturtevant*, of the Scouting Fleet, reported 1 case of typhoid fever in August, and the U. S. S. *Pecos*, of the Asiatic Fleet, 1 case in September. Information regarding the sources of infection has not been received.

TABLE 1.—Summary of morbidity in the United States Navy and Marine Corps for the quarter ended September 30, 1929

	Forces afloat	Forces ashore	Marine Corps	Entire Navy
Average strength.....	75, 132	41, 070	19, 002	116, 202
All causes:				
Number of admissions.....	9, 355	7, 640	5, 239	16, 995
Annual rate per 1,000.....	498.06	744.09	1, 102.83	585.02
Disease only:				
Number of admissions.....	8, 062	6, 586	4, 797	14, 667
Annual rate per 1,000.....	430.28	641.34	1, 009.79	504.88
Communicable diseases, exclusive of venereal disease:				
Number of admissions.....	1, 737	2, 917	982	4, 654
Annual rate per 1,000.....	92.48	284.10	206.72	160.20
Venereal diseases:				
Number of admissions.....	2, 177	540	671	2, 717
Annual rate per 1,000.....	115.90	52.59	141.25	93.53
Injuries:				
Number of admissions.....	1, 169	1, 023	415	2, 192
Annual rate per 1,000.....	62.24	99.63	87.36	73.45
Poisoning:				
Number of admissions.....	104	32	27	136
Annual rate per 1,000.....	5.54	3.12	5.68	4.68



**TABLE 2.—Deaths reported, entire Navy, during the quarter ended September 30, 1929**

Primary	Secondary or contributory	Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
Average strength.....		8,904	1,985	85,868	1,194	17,763	488	116,202
CAUSE, DISEASES								
Abscess, retropharyngeal.....	Pyemia.....			1				1
Alcoholism, chronic.....	Cirrhosis, liver, atrophic.....	1						1
Anemia, pernicious.....	None.....			1				1
Appendicitis, acute.....	None.....			1				1
Do.....	Peritonitis, general, acute.....			1				1
Do.....	Peritonitis, local, acute.....			1				1
Appendicitis, chronic.....	Angina pectoris.....					1		1
Calculus, renal.....	Septicemia.....				1			1
Carbuncle.....	do.....					1		1
Carcinoma, left testicle.....	Metastasis, pulmonary and mediastinal.....			1				1
Carcinoma, squamous cell type, lungs.....	Metastasis, heart, aorta, and liver.....					1		1
Cerebrospinal fever.....	None.....			5				5
Do.....	Pneumonia, lobar.....			1				1
Dysentery, unclassified.....	Myocarditis, acute.....					1		1
Encephalitis.....	Edema, lung.....					1		1
Encephalitis, lethargic.....	None.....	1						1
Do.....	Pneumonia, broncho.....			1				1
Endocarditis, left coronary artery.....	None.....	1						1
Endocarditis, acute ulcerative (malignant).....	None.....			1				1
Endocarditis, acute.....	Coronary embolus.....					1		1
Glioma, cerebral, left temporal lobe.....	None.....	1						1
Goiter, exophthalmic.....	Myocarditis, chronic.....			1				1
Heart block.....	Shock (diving).....			1				1
Hemophilia.....	Hemorrhage, intraabdominal.....			1				1
Myocarditis, acute.....	Pneumonia, lobar.....			1				1
Myocarditis, chronic.....	Angina pectoris.....				1			1
Nephritis, chronic.....	Myocarditis, chronic.....			3				3
Pachymeningitis, cerebral.....	Pneumonia, broncho.....			1				1
Persistent thymus gland.....	None.....			1				1
Syphilis.....	None.....			1	1			2
Do.....	Dementia, paralytica.....			1				1
Stomatitis, gangrenous.....	None.....			1				1
Tuberculosis, pulmonary, chronic.....	None.....			1				1
Do.....	Diabetes mellitus.....			1				1
Valvular heart disease, mitral stenosis.....	Pulmonary edema.....			1				1
Do.....	Myocarditis, chronic.....			1				1
Total for disease.....		4		30	3	5	1	43
CAUSE, INJURIES AND POISONING								
Burns, multiple.....	Edema, lungs.....			1				1
Do.....	Pneumonia, broncho.....			1				1
Crush, left side face and skull.....	None.....			1				1
Fracture, compound, skull.....	None.....			5				5
Do.....	Hemorrhage, subdural.....			2				2
Fracture, simple, skull.....	None.....			3		1		4
Fracture, simple, vertebra.....	None.....			1		1		2
Fracture, near joint, with dislocation pelvis.....	None.....					1		1
Landplane crash, fracture, simple, skull.....	None.....				1	1		2
Heat exhaustion.....	None.....			1				1
Intracranial injury.....	None.....			2				2
Injuries, multiple, extreme.....	None.....			7		3		10
Landplane crash, injuries, multiple, extreme.....	None.....			1	2	1		4
Rupture, traumatic, liver and kidneys.....	None.....			1				1

TABLE 2.—Deaths reported, entire Navy, during the quarter ended September 30, 1929—Continued

Primary	Secondary or contributory	Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
CAUSE, INJURIES AND POISONING—continued								
Rupture, traumatic, small intestines.	None					1		1
Strangulation, neck	None						1	1
Wound, penetrating brain	None			1				1
Wound, penetrating heart and lungs.	Hemorrhage, traumatic, chest.			1				1
Wound, penetrating left chest.	None					1		1
Drowning	None		1	9		2		12
Poisoning:								
Methyl salicylate and mercurochrome.	Alcoholism, chronic			1				1
Methyl salicylate liniment.	None					1		1
Neocarsphenamine, acute (toxic hepatitis).	Hemorrhage, postoperative.					1		1
Narcotic, acute	Alcoholism, acute					1		1
Total for injuries and poisoning			1	38	3	15	1	58
Grand total		4	1	68	6	20	2	101
ANNUAL DEATH RATE PER 1,000								
All causes		1.80	2.02	3.17	20.10	4.50	1.64	3.47
Disease only		1.80		1.40	10.05	1.12	.82	1.48
Injuries				1.30	10.05	2.48	.82	1.44
Drowning			2.02	.42		.45		.41
Poisoning				.05		.45		.14

### STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by naval training stations:

Cumulative data	Number	Per cent of recruits received	Per cent of recruits reviewed
<i>Jan. 1 to Dec. 31, 1928</i>			
All naval training stations:			
Recruits received during the period	13,589		
Recruits appearing before Board of Medical Survey	611	5.50	
Recruits recommended for discharge from the service	410	3.02	67.10
<i>July, August, and September, 1929</i>			
United States naval training station, Hampton Roads, Va.:			
Recruits received during the period	559		
Recruits appearing before Board of Medical Survey	17	3.04	
Recruits recommended for discharge from the service	17	3.04	100.00
United States naval training station, Great Lakes, Ill.:			
Recruits received during the period	834		
Recruits appearing before Board of Medical Survey	13	1.39	
Recruits recommended for discharge from the service	11	1.32	84.62
United States naval training station, San Diego, Calif.:			
Recruits received during the period	1,038		
Recruits appearing before Board of Medical Survey	6	.58	
Recruits recommended for discharge from the service	6	.58	100.00
United States naval training station, Newport, R. I.:			
Recruits received during the period	587		
Recruits appearing before Board of Medical Survey	60	10.22	
Recruits recommended for discharge from the service	17	2.90	28.33

The following cases, selected from reports of medical survey recently received by the bureau, are presented to indicate conditions existing prior to enlistment which led to early separation from the service. These conditions were so evident that the men should have been rejected at their respective recruiting stations.

The men, in the following cases, were all apprentice seamen with less than one month's service. Physical defects responsible for their discharge from the Navy were discovered when they were reexamined at a naval training station within a few days after they were enlisted.

*Dental defects.*—Enlisted at Cleveland, Ohio, November 1, 1929. Practically every tooth was found to have one or more cavities, several were devitalized, while the general condition of this man's mouth indicated that he would be edentulous before his enlistment could be completed. Surveyed November 7, 1929.

Enlisted at Brooklyn, N. Y., October 21, 1929. This recruit had only two molar teeth in the lower jaw. Of these, one was nonvital and the other abscessed and had to be extracted. He was underdeveloped, pale, and anemic. Surveyed November 7, 1929.

Enlisted at Chicago, Ill., November 23, 1929. His teeth were generally unsound and showed evidence of faulty calcification. Teeth Nos. 1, 16, 17, and 32 were missing or impacted; Nos. 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 18, 19, 20, 28, 30, and 31 were carious, and there was probable pulp involvement in others. Extraction of teeth Nos. 4, 13, 28, and 31 was indicated. Surveyed November 30, 1929.

*Defective physical development.*—Enlisted at Philadelphia, Pa., October 9, 1929. Examination showed a very flat-chested, emaciated individual of the phthisical type. His height was 70 inches, weight 126 pounds, and chest expansion 2 inches. There was impaired resonance of both apices, with roughened breath sounds. A few crackling râles were heard after coughing. His afternoon temperature was 100° F.; his pulse rate, 100; and blood pressure, 100/60. Tubercle bacilli were not found in the sputum. Urinalysis showed 2 plus albumin, hyaline, and granular casts. Surveyed October 17, 1929.

*Constitutional psychopathic inferiority, without psychosis.*—Enlisted at Birmingham, Ala., December 2, 1929. He had the intellectual attainments of one in the third grade of school and his mentality was that of a moron. His history gave no evidence of familial mental disease, but indicated that his entire family was of his intellectual level. He had a moderate varicocele and scoliosis of a moderate degree. The right shoulder was about 2 inches lower than the left. He was unable to read any of the first five plates of the Stilling's test and unable to match the color shades of the Jennings's test. Surveyed December 7, 1929.

*Hernia.*—Enlisted at Milwaukee, Wis., November 23, 1929. Physical examination revealed a right inguinal hernia. When the patient coughed an impulse was felt at the external ring and the hernia descended into the scrotum. Surveyed November 30, 1929.

Enlisted at Portland, Oreg., November 19, 1929. Routine examination of this recruit showed a well-defined right inguinal hernia which, the recruit stated, had been present since childhood. The hernia was easily reduced when the patient was recumbent. Operation was refused. Surveyed November 23, 1929.

*Otitis, media, chronic.*—Enlisted at Raleigh, N. C., November 5, 1929. History of scarlet fever at the age of 4 years, followed by recurrent attacks of ear trouble. Examination disclosed a large perforation of the left tympanum, exposing the cavity of the middle ear. The discharge had a foul odor. Staphylococci, streptococci, and unidentified bacilli were found in the pus. Hearing, right ear, 15/15; left ear, 0/15. Surveyed November 21, 1929.

Enlisted at Buffalo, N. Y., November 21, 1929. This recruit gave a history of ear trouble for the past five years. He had a perforation of the left tympanum, with impairment of hearing and a marked purulent discharge. The right tympanum was retracted and there was a calcareous deposit on the drum membrane posteriorly. His teeth were generally defective. Surveyed November 23, 1929.

Enlisted at Nashville, Tenn., November 15, 1929. This patient gave a history of periodical attacks of ear trouble since childhood. He had a large perforation of the right ear drum. Hearing was slightly impaired. Surveyed November 18, 1929.

Enlisted at St. Louis, Mo., November 26, 1929. Mastoiditis required a radical operation six months previously. An examination of the external auditory canal showed the presence of an acute inflammation, with swelling of the tissues. Surveyed November 30, 1929.

*Flat feet.*—Enlisted at Norfolk, Va., November 25, 1929. History of foot trouble since childhood. He stated that he had pain over the dorsum of the feet and in the calves of the legs after walking or standing for a short period of time. Examination revealed flat feet of marked degree, with eversion. His weight was largely borne on the inner border of the feet. Surveyed November 27, 1929.

Enlisted at Detroit, Mich., December 2, 1929. Examination disclosed very flat feet, with bony exostoses on the extensor surfaces and at the base of the first metatarsal bones of both feet. Surveyed December 4, 1929.

*Deformity.*—Enlisted at Birmingham, Ala., December 2, 1929. This man had a sprain of the lumbar vertebrae at the age of 12 years and since then has had a decided limp. Examination showed a noticeable tilt of the pelvis to the right. The crest of the right ileum was about  $1\frac{1}{2}$  inches lower than the left and the distance from the anterior-superior spine to the tip of the external maleolus was  $1\frac{1}{2}$  inches greater on the left than on the right. He also had flat feet of a moderate degree. Urinalysis showed a trace of albumin, pus cells, and mucus. Surveyed December 5, 1929.

Enlisted at Cleveland, Ohio, November 1, 1929. He had a deformity of the left elbow due to faulty union of a fracture sustained at the age of 8 years. Extension of the arm was limited and there was definite shortening. He was unable to assume the position of attention without considerable external rotation of the left shoulder. He also had a deformity of the right ala nasae due to an improperly treated laceration. Surveyed November 5, 1929.

Enlisted at Little Rock, Ark., September 26, 1929. He complained of pain and soreness of the left foot as a result of an injury received during a basket-ball game about eight months before. Examination showed a bluish scar on the dorsum of the left foot, with tenderness on pressure. There has been an intermittent discharge of pus from the wound. Radiograph revealed a rarefaction of the distal end of the first metatarsal bone. Surveyed October 2, 1929.

*Amblyopia.*—Enlisted at New York, N. Y., September 23, 1929. Defective vision, right eye 20/70-1, left eye 20/50-1; nystagmus at 45; divergent squint; depressed arches; lordosis; and underweight (107 pounds) were found during physical examination. Surveyed October 1, 1929.

*Color blindness.*—Enlisted at Little Rock, Ark., November 27, 1929. He was unable to read any of the plates of the Stilling's test and made 100 per cent of error in the selection of colors to match the test skeins of the Jennings's test. He denied knowledge of any defect in color vision. Surveyed December 3, 1929.

*Hyperthyroidism.*—Enlisted at New Orleans, October 9, 1929, and was admitted to hospital 12 days later. Examination showed extreme nervousness, irritability, weakness, mild tachycardia, muscle twitchings, and flushing of the face. His skin was warm and moist, hands perspired freely, and his eyes were large, bright, and staring. Both lobes of the thyroid gland were moderately enlarged. Basal metabolism rates were repeatedly plus 40 and over. Surveyed November 1, 1929.

*Arterial hypertension.*—Enlisted at Raleigh, N. C., October 2, 1929. Blood-pressure readings over a period of four days averaged

150/68. The radial arteries were slightly fibrosed. Urinalyses showed the presence of albumin, which varied from a trace to 3 plus, pus cells, some epithelium, and many red cells. No subjective symptoms were elicited. Surveyed October 9, 1929.

#### ADMISSIONS FOR INJURIES AND POISONING, THIRD QUARTER, 1929

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the third quarter, 1929, is based upon all Form F cards covering admissions in those months which have reached the bureau:

	Admissions July, Au- gust, and September, 1929	Admission rate per 100,000 per annum	Admission rate per 100,000, year 1928
<b>INJURIES</b>			
Connected with work or drill.....	1,034	3,559	2,852
Occurring within command but not associated with work.....	630	2,169	1,855
Incurred on leave or liberty or while absent without leave.....	528	1,818	1,139
All injuries.....	2,192	7,546	5,846
<b>POISONING</b>			
Industrial poisoning.....	4	14	27
Occurring within command but not connected with work.....	114	392	125
Associated with leave, liberty, or absence without leave.....	18	62	42
Poisoning, all forms.....	136	468	194
Total injuries and poisoning.....	2,328	8,014	6,040

#### Percentage relationships

	Occurring within command				Occurring out- side command	
	Connected with the perform- ance of work, drill, etc.		Not connected with work or prescribed duty		Leave, liberty, or A. W. O. L.	
	July, August, and Sep- tember, 1929	Year 1928	July, August, and Sep- tember, 1929	Year 1928	July, August, and Sep- tember, 1929	Year 1928
Per cent of all injuries.....	47.2	48.8	28.7	31.7	24.1	19.5
Per cent of poisonings.....	2.9	13.8	83.8	64.4	13.2	21.8
Per cent of total admissions, injury, and poisoning titles.....	44.6	47.7	32.0	32.8	23.4	19.5

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction" or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from July, August, and September, 1929, reports, are worthy of notice from the standpoint of accident prevention:

*Gasoline, carelessness in the use of.*—A gunner's mate, third class, engaged in cleaning guns on board a destroyer, lit a cigarette while his hands were moist with gasoline. Injury, burns of both hands. Loss of time, 31 days.

A fireman, first class, who was negligent and careless in handling a gasoline blowtorch, suffered severe burns of the face and chest, and a fireman, third class, multiple burns, when the torch exploded. The former was on the sick list 85 days and the latter 144 days.

*Unlighted gangway.*—A mess attendant passing along a gangway connecting two destroyers slipped and fell between the ships. The gangway should have been lighted. Injury, contusion of the sacral region. Loss of time, 6 days.

*Firearms, careless handling of.*—An enlisted man of the Marine Corps was carelessly playing with a loaded rifle, when the weapon was accidentally discharged. Two privates were wounded. One sustained a punctured wound of a leg and the other punctured wounds of the left leg, chest, and right thigh. Total loss of time, 45 days.

*Failure to wear protective goggles.*—A piece of steel became embedded in the eye of a seaman, first class, who was "chipping out" rivets from the steel deck of a destroyer. The cornea became opaque, cataract developed, and the eye was finally enucleated. He was invalided from the service after 67 days' treatment in a hospital.

*Dangerous practice with machinery.*—Due to gross negligence of others, an inexperienced apprentice seaman at a training station, who was unaware of machinery hazards and not warned of the danger, was ordered to clean the chains of an ironing machine while the machine was in motion. As might have been anticipated, his hand was caught between the chain and gears. Fortunately, he did not lose his entire hand. Injury, lacerated wounds of all the fingers, right hand. Loss of time, 26 days.

*Steam line hazards.*—A machinist's mate, second class, was repairing a steam line on board a destroyer when a fellow worker accidentally turned on the steam. Injury, multiple burns of the face, chest, and shoulders. Loss of time, 15 days.

*Unsafe practice with a fork.*—A seaman, second class, employed a table fork in place of a screw driver to tighten a screw on his bunk. The fork slipped and inflicted a punctured wound of the right eyeball. He was treated in a hospital for 78 days and finally discharged to duty.

*Poisonous insect hazards.*—Having neglected to examine beforehand the banana he was eating, a marine serving in Haiti received a sting of the lip from a scorpion whose presence on the fruit was unsuspected. Loss of time, 2 days.

*Acute poisoning by sodium fluoride.*—Due to the mistake of a cook, a chief carpenter's mate on board a battleship was on the sick list two days after eating hot cakes in the preparation on which sodium fluoride had been used in place of baking powder. Obviously, containers holding poisonous substances should not be stored in the ship's galley or other places where food is habitually prepared.

*Chemical burn—cresol.*—A signalman, first class, bathing in the crew's washroom, sustained chemical burns of both feet from cresol which had been used on the deck as a disinfectant. Loss of time, 6 days.

*Chemical burn—iodine.*—In two instances chemical burns of the eye were sustained when tincture of iodine was mistaken for silvol and instilled in the conjunctival sac. Loss of time, 5 days and 10 days, respectively. All of the factors leading to the above two accidents are not known. It would seem, however, almost unnecessary to call attention to the general practice not only of having all bottles containing medicinal preparations properly labeled but also of reading the label before removing some of the contents and again before administering or applying the remedial agents.

In the treatment of diseases and conditions of the eye it is good practice to keep irritating or caustic preparations in bottles of distinctive size, shape, or color or in bottles differing in size, shape, or color from those containing preparations which do not have irritating or caustic properties. For instance, tincture of iodine should be kept in bottles very different from those containing silvol, and silver nitrate in bottles distinctive from those containing preparations of cocain, procain, etc.





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*Edited by*

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NAVY DEPARTMENT,  
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The UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,  
*Acting Secretary.*

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## PREFACE

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The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April, 1907, as means of supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes, and comments on topics of medical interest, and reviews or notices of the latest published medical books.

The bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of commendation to authors of papers of outstanding merit and will recommend that copies of such letters be made a part of the official records of the officers concerned.

The bureau does not necessarily undertake to indorse all views or opinions which may be expressed in the pages of this publication.

C. E. RIGGS,  
*Surgeon General United States Navy.*

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# U. S. NAVAL MEDICAL BULLETIN

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## SPECIAL ARTICLES

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### THE VALUE OF HIGH OXYGEN IN PREVENTING THE PHYSIOLOGICAL EFFECTS OF NOXIOUS CONCENTRATIONS OF CARBON DIOXIDE<sup>1</sup>

By E. W. BROWN, Commander, Medical Corps, United States Navy

#### I. INTRODUCTION

The disasters to the *S-51* and *S-4* within recent years have aroused renewed interest in the subject of methods of rescue for submarines. Among the various measures for rescue, a vital consideration is provision for the regeneration of the air in order that the crew may survive while rescue operations are being conducted.

Soda lime is supplied to submarines to prevent dangerous accumulation of carbon dioxide, and oxygen is provided in the form of the compressed gas. The limitations of weight and space in submarines are such that these supplies are necessarily very restricted. As a result of careful investigation, information is now available as to the maximum absorptive efficiency of soda lime for CO<sub>2</sub> under the usual ventilation conditions; and the maximum time that the oxygen will last from the standpoint of survival is known for all practical purposes.

There are, however, certain questions which still arise in naval circles. One of these may be formulated as follows: To what extent, if any, will the maintenance of the normal oxygen concentration minimize the effects of high carbon dioxide on men resulting from rebreathing air in submarines? Would life be materially prolonged if oxygen deficiency were prevented while carbon dioxide was accumulating to a dangerous percentage?

Another important question is the effect of high carbon dioxide with or without oxygen deficiency on the physical and mental efficiency of men in submarines. The efficiency curve will fall, of course, when the atmosphere is vitiated by a high concentration of CO<sub>2</sub>. It should, however, be determined, if possible, what concentration would induce effects leading to such a loss of efficiency that the boat could not be properly operated by the personnel. It is also

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<sup>1</sup> From the Medical Research Division, Edgewood Arsenal, Edgewood, Md.

possible that mental efficiency may be more seriously affected than physical stamina and may occur earlier. There is apparently no record in the literature of the effect of high  $\text{CO}_2$  on mental efficiency although some work has been carried out in reference to physical efficiency.

The plan of the present investigation was, therefore, to determine the following:

(1) A comparison of the noxious effects of  $\text{CO}_2$ , the maximum percentage being at practically 6 per cent, under two sets of conditions, i. e., (a) oxygen being supplied to prevent deficiency and (b) the oxygen being allowed to fall as  $\text{CO}_2$  accumulated. It will be noted that what is meant by relatively high oxygen in the title of the article is actually the maintenance of oxygen at or a little above normal under conditions of rebreathing the air in a closed space.

(2) The influence of high carbon dioxide at a maximum approximating 6 per cent on physical and mental efficiency of the personnel.

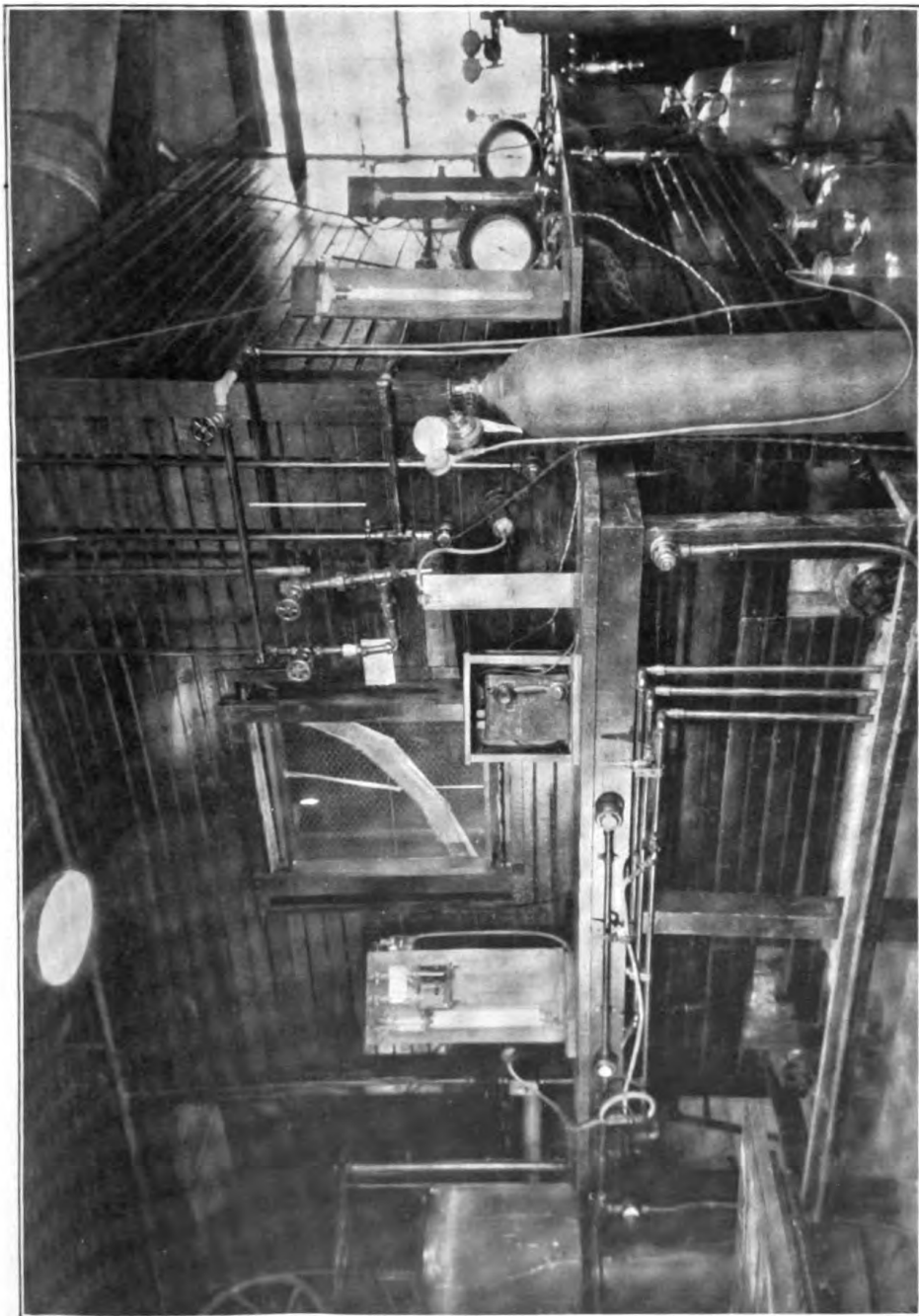
## II. EXPERIMENTAL

### A. APPARATUS

(1) *The respiration chamber (photos A and B).*—The rebreathing tests were carried out in a respiration chamber constructed of a heavy outer wooden casing which was lined and floored with heavy sheet lead. Entrance to the chamber was effected by a rectangular opening in the rear wall 15 by 22 inches. This was closed by a section of heavy plate glass fitting closely into a lead flange projecting outward and sealed with a plastic wax. The chamber was provided with one large window at the front and two small windows in the ceiling. The interior dimensions of the chamber were as follows: 7 feet 8 inches wide, 8 feet 3 inches long, and 9 feet 9 inches high. The net cubical capacity was 654 cubic feet, deductions having been made for the displacement of the interior fittings and furniture, and a small volume added formed by the recesses of the door frame and front window.

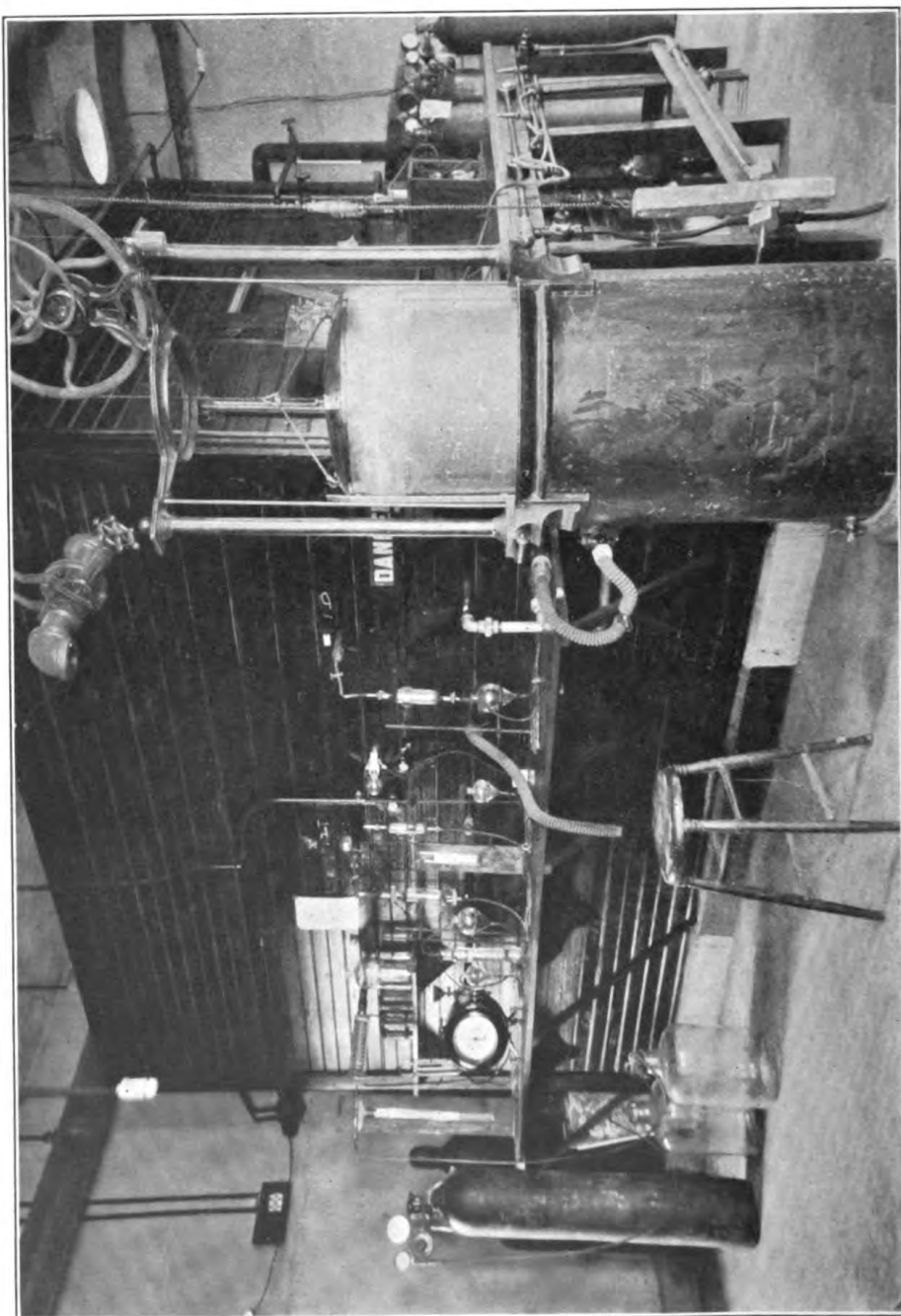
It was, of course, imperative to establish an adequate degree of air-tightness of the respiration chamber in order to control the composition of the air under experimental conditions. Considerable difficulty was encountered in rendering it sufficiently air-tight on account of the large number of fittings piercing the side walls. This was, however, successfully accomplished, the criterion being as follows: The chamber was sealed and placed under a vacuum of 2 inches of water. If the fall of the gauge did not exceed 1 inch over a period of one hour the leakage was considered negligible for the purposes of these tests. Under these conditions it was found that starting with 5 per cent of  $\text{CO}_2$  in the sealed chamber, the air being continuously





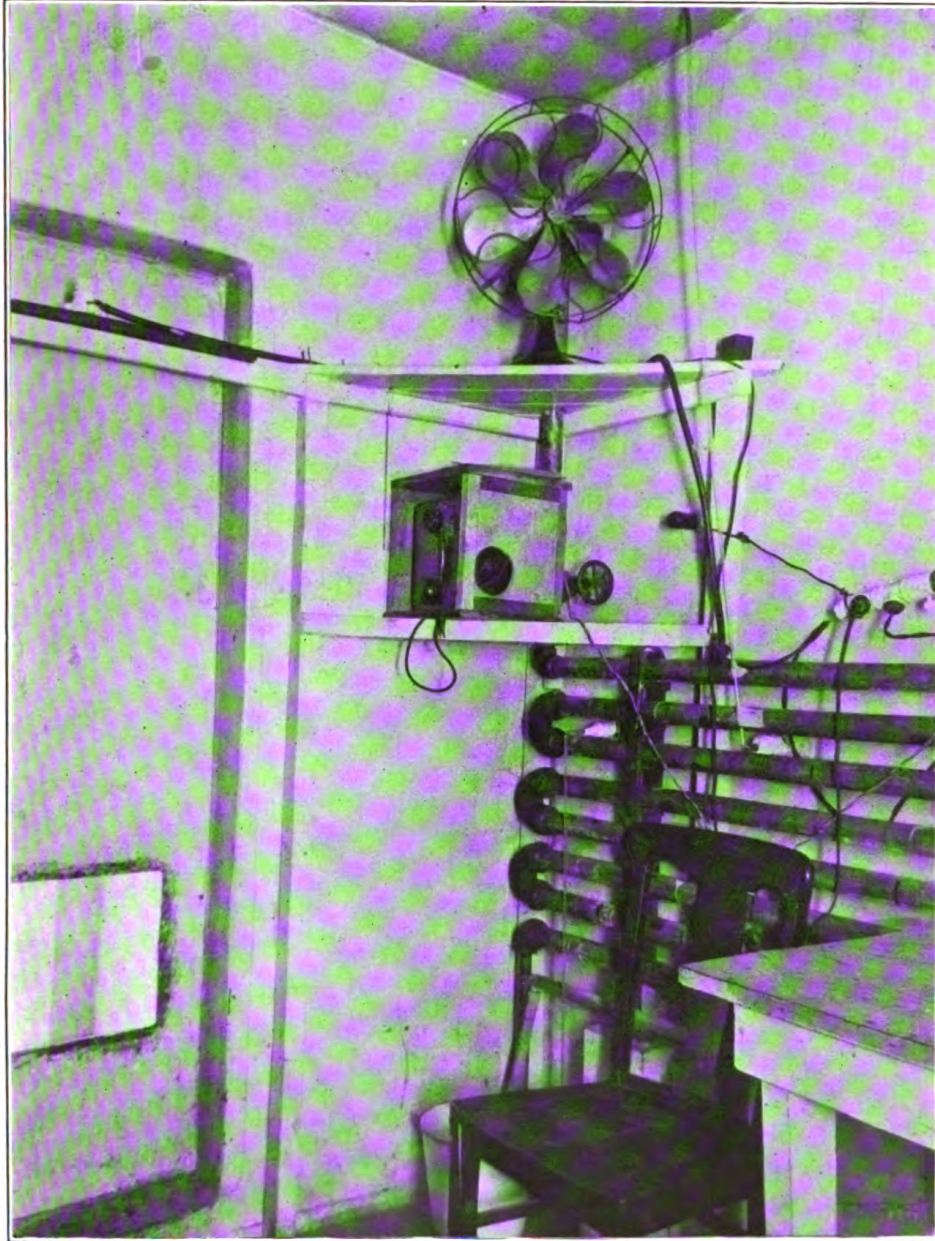
PHOTOGRAPH A. FRONT AND RIGHT SIDE ELEVATION OF RESPIRATION CHAMBER

524-1



PHOTOGRAPH B. FRONT AND LEFT SIDE ELEVATION OF CHAMBER

524-2



PHOTOGRAPH C. INSIDE OF CHAMBER LOOKING TOWARD ENTRANCE

524—3



well stirred, the air contained 4.8 per cent at the end of 12 hours, i. e., a negligible decrease.

(a) *Equipment of the respiration chamber (photo C).*—The interior equipment of the chamber was as follows: Cooling coils; 3 electric lights; three 16-inch fans of the office oscillating type for mixing the air; a field service telephone set; 7 thermometers hung at various points in order to establish the average temperature; a Tycos recording wet and dry bulb thermometer affording automatic records; 4 capillary glass tube connections, 2 terminating at the top and 2 at the bottom of the chamber and so placed as to provide for representative air sampling from the outside; 4 glass tube connections for the entrance of carbon dioxide, oxygen or air, all glass tubing in each instance being passed through a rubber stopper inserted into a section of pipe connected to the chamber. A table, chairs, and a cot were included.

The exterior equipment was as follows: Wet test meters of 1,000-liter capacity connected to calibrated flowmeters for the measurement of gas flow into the chamber; a manometer for registering the internal pressure of the chamber; a spirometer of 150 liters capacity for two functions, i. e., (1) as a balancer to offset sudden changes of pressure in the chamber, (2) as a method of recording the minute-expiration volume of subjects expiring into the apparatus from within the chamber.

(b) *The air-cooling system.*—A cooling arrangement was essential to maintain the temperature of the chamber within the comfort range for the experimental subjects. A system of galvanized 2-inch iron piping was installed, made up of 8 coils and running around three sides of the chamber. This was connected to the cold-water service supply of the laboratory and so arranged as to permit valvular control of the rate of flow from the outside. The experiments were conducted during the months of January, February, and March and in the early part of April, when the service-water supply was sufficiently cold for the control of the chamber temperature.

(2) *Apparatus for air analysis.*—The Orsat-Henderson gas analysis apparatus was employed for the estimation of  $\text{CO}_2$  in all the tests. It is conveniently adapted for the analysis of oxygen if not in excess of 22 per cent. In the experiments involving such high percentages the ordinary type of Orsat apparatus was used and is sufficiently accurate for the oxygen in tests of this type. It is not, however, sufficiently accurate for  $\text{CO}_2$  and was not used for this purpose.

#### B. PROCEDURE

(1) *Air sampling.*—Gas-collecting tubes of 75 and 150 cubic centimeter capacity with 3-way cocks were found convenient for this

purpose. The tubes were filled with a 1 per cent sulphuric-acid solution by means of a leveler of standard type, and connected to the sampling capillary air line of the chamber. The upper stopcock of the sampling tube was turned to the outside air and connected to the stopcock of a cylinder filled with 1 per cent sulphuric-acid solution. The air-sampling line was then flushed out by opening the stopcock at the bottom of the cylinder thus allowing the escape of the solution. The stopcock of the sampling tube was then turned to the gas-collecting tube and the air sample taken by lowering the leveler. Four samples of air were taken from each sampling line, all within a period of 3 to 5 minutes, at designated intervals.

(2) *Supply of carbon dioxide and oxygen to the chamber.*—The gas desired was released from the cylinder through a reducing gauge, passing first through two equalizing bottles, through a flow meter, and through a wet meter to the interior of the chamber. It was not considered desirable to permit the pressure of the chamber to exceed 3 inches of water as indicated by the manometer. If this occurred, connection to the spirometer was made to the chamber and the pressure reduced.

A flow meter and wet meter were both employed, one as a check against the other, to measure the rate and volume of flow. The constant supervision of one man was necessary to regulate this procedure.

(3) *Temperature of the respiration chamber.*—This was taken as the average of the readings of 7 thermometers, 3 hung from the ceiling and 1 in each corner.

(4) *Minute expiration volume of the subjects.*—This represents the volume in liters of expired air per minute and, of course, is virtually equal to the volume of inspired air per minute. A large spirometer of 150 liters capacity situated outside the respiration chamber and connected to the interior by 1-inch piping was used for the collection of the expired air. The procedure was as follows: A gas mask of the standard Navy type was adjusted to the subject, the mask being provided with inspiratory and expiratory valves contained in a glass assembly. The inspiratory valve was open to the air of the chamber, the expiratory connected by a gas-mask hose piece to the pipe passing through the wall of the chamber to the spirometer.

After adjustment of the mask, the valves were so arranged that the subject first exhaled to the outside air for 3 minutes. The period of breathing into the spirometer was set at 5 minutes. The subject was practically not conscious of any peripheral resistance, the connecting tubing being approximately 1 inch in diameter.

It was not found necessary to correct the data for expiration volume to standard conditions of temperature and barometric pressure, i. e., 0° C., and 760 millimeters. Corrections were calculated in typical instances, but the alterations in volume were not

sufficient to be significant from the comparative standpoint. The data as recorded therefore, represent the volumes under the existing conditions of temperature and pressure.

(5) *The pulse rate, respiratory rate, and body temperature.*—The pulse rate was ordinarily recorded graphically by the MacKenzie-Lewis polygraph which proved to be not satisfactory.

The respiratory rate was recorded graphically by means of the Mary-Jacquet pneumograph connected by rubber tubing to a tambour of the Becker type, the tracings being made on smoked paper carried on a kymograph. The time employed was recorded in fifths of seconds; 3-minute readings were usually taken. The entire apparatus functioned satisfactorily. The subjects were so seated as to face away from the kymograph and were, therefore, unaware of the starting or completion time of the records; the psychological factor thus being reduced to a minimum.

The body temperature was taken by mouth.

(6) *The Schneider index.*—This is the index of circulatory efficiency devised by Schneider. The technique is described in detail in the Manual of the Medical Department of the Navy. It affords a fairly adequate indication of the cardiovascular tone following stress and strain, provided that careful control tests are conducted.

(7) *Tests of mental efficiency.*—Army alpha intelligence tests and standard cancellation and addition procedures were utilized. The reactor apparatus employed by the Army and Navy Air Corps to determine the effects of the low oxygen on motor coordination and attention in connection with the rebreathing apparatus was employed in the present study. It was not, however, used with the low oxygen as employed in testing aviators.

(8) *The general routine of the tests.*—The duration of the tests varied from 8 to 12 hours. The number of subjects were ordinarily four and were not aware of the air mixtures being used, thus eliminating the psychological factor of oxygen. In the majority of the experiments carbon dioxide was introduced in a definite volume with the purpose of reducing the time required to reach the designated concentration from accumulation by rebreathing. In this way it was feasible to secure the desired physiological effects and yet shorten the time of the run by 3 to 4 hours.

The general routine follows:

(a) Freely ventilating and sealing up of the chamber with four subjects, at approximately 8 a. m.

(b) Air sampling: Four samples taken at the beginning, the end of the fourth hour, and every two hours thereafter.

(c) Temperature of the chamber: All thermometers were read at the start and every hour throughout.

(*d*) Regulation of the temperature of the chamber: This was kept between 20° and 23° C., by adjustment of the flow of water through the cooling coils.

(*e*) Ventilation: One fan was kept continuously in operation throughout; three fans for one-half hour prior to and during the air-sampling periods.

(*f*) Pulse rate, respiration rate, expiration volume, and body temperature: These physiological data were all taken at the beginning, the end of the fourth hour, and every two hours thereafter.

(*g*) Introduction of carbon dioxide and oxygen: When desired to employ either or both, the gas was metered uniformly into the chamber from the beginning for a definite number of hours according to the requirements of the test.

(*h*) The Schneider index: This was carried out in connection with certain of the tests, being determined before the run and near the termination of the test.

(*i*) Clinical data: A careful record was kept of the symptoms of each subject, such as the progressive effect on respiration, fatigue, weakness, headache, dyspnea, nausea, and chilliness. A questionnaire was filled out the following day by all the subjects relative to the after effects, if any, of the test.

(*j*) Observers: A medical officer with an assistant ordinarily entered the chamber at the beginning of the last hour, remaining until the completion of the experiment.

(9) *Subject of the tests.*—The men from whom the subjects were selected were as follows: 1 submarine officer, 8 submarine enlisted men and 2 Hospital Corps men. The ages varied from 19 to 30 with an average of 25 years. One Hospital Corps man ordinarily served as a subject and was in charge of the collection of the physiological data.

The subjects are designated by letters, i. e., A, B, C, etc., and it will be understood that four were employed for each test unless otherwise specified.

#### C. DISCUSSION OF THE DATA

(1) *Tests without the supply of oxygen.*—In this group of tests oxygen was not supplied to the respiration chamber to compensate for the deficiency resulting from rebreathing.

(a) *With maximum carbon dioxide and minimum oxygen at 4.7 and 15.5 per cent (test No. 1):*



TABLE 1

Subjects: K, C, E, F.

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature (average)	Relative humidity	Pulse per minute				Respiration per minute				
					K	C	E	F	K	C	E	F	
Start.....	0.0	20.8	75	47									
End fourth.....	1.0	18.8	70	50	70	64	69	63	15	15	13	17	
End sixth.....	2.2	17.6	70	54	79	78	68	53	14	14	17	19	
End eighth.....	3.4	16.8	72	55	74	72	64	59	17	18	17	21	
End tenth.....	4.7	15.5	72	64	73	72	67	64	17	16	17	21	

No carbon dioxide or oxygen was supplied to the chamber, the duration of the test being 10 hours. The average rise of carbon dioxide per hour per man was 0.12 per cent; the average decrease per hour of oxygen 0.14 per cent.

The physiological effects: The first slight effect on respiration was reported generally by the subjects between the fourth and fifth hours, with an estimated carbon dioxide of approximately 2 per cent. It was, however, noted only on active exertion.

The depth of breathing for all subjects was markedly increased at the end of the eighth hour at 3.5 per cent of carbon dioxide but was not labored. The condition progressed rather rapidly during the last or tenth hour, and was fatiguing but not distressing. None of the subjects noted actual dyspnea and there was no indication of cyanosis. Subject E complained of a slight headache during the final three hours.

The pulse readings show no significant variations. The respiration rate increased from 3 to 4 during the course of the run. The blood systolic pressure showed a distinct tendency to rise with subject K from a normal 105/86 to 120/90 in the final hour of test 1. It was not recorded for the other subjects.

There were no marked after effects except that of muscular soreness reported by all subjects and most marked in the region of the diaphragm.

Impression: At a concentration of carbon dioxide of 4.7 per cent and a corresponding reduction of oxygen to 15.4 per cent it would be practicable from the physical standpoint for submarine men to carry on their duties efficiently for a considerable time provided severe exertion was not required. The outstanding physical effect was general fatigue and a certain degree of listlessness. It is not believed that the alertness of the men was materially reduced.

(b) *With maximum carbon dioxide and minimum oxygen at 4.8 and 17.8 per cent (test No. 15):*

TABLE 2

Subjects: B, K, I.

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature average	Relative humidity	Pulse per minute			Respiration per minute		
					B	K	I	B	K	I
	<i>Per cent</i>	<i>Per cent</i>	<i>° F.</i>	<i>Per cent</i>						
Start.....	0.0	20.8	75	53	77	75	63	16	16	19
End of second.....	2.0	19.6	73	71	67	70	62	13	18	23
End of fourth.....	4.0	18.6	73	77	77	65	79	16	21	28
End of fifth.....	4.8	17.8	75	74	78	72	73	18	22	28

Time, hours	Expiration, liters per minute			Body temperature		
	B	K	I	B	K	I
Subject.....				<i>° F.</i>	<i>° F.</i>	<i>° F.</i>
Start.....	12	10	15	98.6	97.8	96.2
End of fourth.....	14	14	12	97.8	97.8	96
End of sixth.....	25	39	29	97.6	97.6	97.4
End of seventh.....	33	39	27	97.6	95.8	96.4

Five hundred and twenty liters of carbon dioxide were introduced into the chamber. No oxygen was supplied. The duration of this test was only  $5\frac{1}{3}$  hours. The maximum carbon dioxide was practically equivalent to that of test No. 1, but the oxygen was considerably higher, i. e., 17.8 per cent as compared with 15.5 per cent.

The physiological effects: Subject I reported a mild headache during the final hour and persisting for one hour following the test. All of the subjects noted chilly sensations during the final hour and a half despite the fact that the temperature of the chamber averaged 75° F. The final body temperatures for subjects B, K, and I showed a net drop of 1°, 3°, and 2.2°, respectively. Comfort conditions should have prevailed with the final average chamber temperature at 75° F., and the relative humidity at 74.

All subjects noted an initial though slight effect on respiration after exertion at the end of the second hour at 2 per cent of carbon dioxide. The subjects developed panting at approximately 4 per cent carbon dioxide, but there was no actual distress even at 4.8 per cent. The situation appeared to be rather one of fatigue as a result of the strain of the hyperpnea. The latter progressed to approximately the same extent as was noted in test No. 1. The final increase in respiratory rate varied in the subjects from 3 to 9 per minute. There were virtually no after effects except for chilliness and fatigue in two subjects, persisting for about an hour.

Impression: The physiological effects closely paralleled those in test 1, although the final oxygen reading was 2.4 per cent higher. Again the tendency to fatigue and listlessness was outstanding.

(c) *With maximum carbon dioxide and minimum oxygen at 5.2 and 15.8 per cent (test No. 13):*

TABLE 3

Carbon dioxide: Introduced into chamber, 273 liters.  
Oxygen: None.  
Duration: 8¼ hours.  
Subjects, B, L, H, S.

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature average	Relative humidity	Pulse per minute				Respiration per minute				
					B	L	H	S	B	L	H	S	
	<i>Per cent</i>	<i>Per cent</i>	<i>° F.</i>	<i>Per cent</i>									
Start.....	0.0	20.9	77	54	82	102	80	82	15	17	17	15	15
End of fourth.....	3.3	18.4	75	85	69	80	73	65	15	20	20	15	15
End of sixth.....	4.1	17.4	73	76	69	88	72	67	17	20	17	17	17
End of eighth.....	5.2	15.6	73	73	81	81	70	72	16	22	24	24	24

Time, hours	Expiration, liters per minute				Body temperature			
	B	L	H	S	B	L	H	S
Subject.....					<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>
Start.....	17	12	9	8				
End of fourth.....	16	20	18	19				
End of sixth.....	21	43	21	28				
End of eighth.....	29	50	35	39	97.8	97.6	97.8	97.8

Time, hours	Blood pressure							
	B		L		H		S	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
Start.....	112	72	116	70	113	69	116	76
End of eighth.....	117	78	128	81	140	64	114	64

The final carbon dioxide was 0.5 per cent higher and the oxygen 0.3 per cent higher than in test No. 1.

Physiological effects: Much more marked than in tests 1 or 15 for subjects I, S, and L. Subject H complained only of slight fatigue. He proved, however, to be remarkably resistant to high carbon dioxide throughout all of the tests. Subjects S and L reported dyspnea in the last half hour, which had not been noted in the previous runs. Breathing was decidedly labored for all subjects.

The respiratory rate was not increased beyond that of the former tests. The final increase in expiration volume per minute during test No. 13 varied from 12 to 31 liters per minute. Chilliness was a constant symptom during the last hour, and the final body temperatures were subnormal—i. e., 97.6° to 97.8° F. for all subjects. Subject H showed an increase of systolic blood pressure of 27 millimeters, the others only slight change.

Impression: An increase of from 4.7 to 5.2 per cent or 0.5 per cent carbon dioxide led to a marked increase in the physiological effects. The symptoms progressed rapidly from 4.5 to 5 per cent of carbon dioxide. Fatigue was more marked in this test.

(d) *With maximum carbon dioxide at 5.6 to 5.8 per cent; minimum oxygen 16.1 to 14.2 per cent (tests 8, 14, and 20):*

TABLE 4

Carbon dioxide: Introduced into chamber, 260 liters.  
Oxygen: None.  
Duration: 8 hours.  
Subjects: H, I, J, K.

[Test No. 8]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature average	Relative humidity	Pulse per minute				Respiration per minute				
					H	I	J	K	H	I	J	K	
	<i>Per cent</i>	<i>Per cent</i>	<i>° F.</i>	<i>Per cent</i>									
Start.....	0.0	20.9	70	71	76	75	72	75	18	20	20	20	20
End of fourth.....	3.6	18.4	72	75	62	67	68	66	19	20	19	11	11
End of sixth.....	4.6	16.1	70	71	70	66	69	60	20	21	17	26	26
End of eighth.....	5.7	15.6	72	77	87	68	72	67	24	23	30	25	25

Time, hours	Blood pressure							
	H		I		J		K	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
Start.....	113	69	109	51	116	76	100	67
End of eighth.....	112	74	122	58	110	68	106	74

TABLE 5

Carbon dioxide: Introduced into chamber, 325 liters.  
Oxygen: None.  
Duration: 8½ hours.  
Subjects: L, S, H, J.

[Test No. 14]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature average	Relative humidity	Pulse per minute				Respiration per minute				
					L	S	H	J	L	S	H	J	
	<i>Per cent</i>	<i>Per cent</i>	<i>° F.</i>	<i>Per cent</i>									
Start.....	0.0	20.9	70	60	76	68	63	63	15	16	15	16	16
End of fourth.....	3.2	18.4	75	77	70	61	61	61	15	15	17	18	18
End of sixth.....	4.8	17.1	75	73	76	66	65	60	20	21	20	21	21
End of eighth.....	5.7	15.4	77	82	-----	-----	76	61	26	19	20	19	19

Time, hours	Expiration, liters per minute				Body temperature			
	L	S	H	J	L	S	H	J
					<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>
Start.....	11	14	14	14	98.8	98.6	98.2	98
End of fourth.....	22	24	26	21	98.6	98.4	98.4	97.6
End of sixth.....	26	28	27	38	97.6	97.4	97.6	97.2
End of eighth.....	51	42	46	67	Not observed.			

TABLE 6

Carbon dioxide: None added during test.  
 Oxygen: None added during test.  
 Duration: Eight hours.  
 Subjects: L, S, I, J, P, O.

[Test No. 20]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature, average	Relative humidity	Pulse per minute				Respiration per minute				
					L	S	I	J	L	S	I	J	
	Per cent	Per cent	° F.	Per cent									
Start.....	0.0	20.9	81	49	88	64	79	72	14	19	16	12	
End of fourth.....	3.0	17.7	77	74	80	68	66	74	16	30	22	14	
End of sixth.....	4.8	15.9	77	78	96	68	70	70	51	34	32	18	
End of eighth.....	5.8	14.2	79	76	118	72	78	74					

Time, hours	Expiration, liters per minute			Body temperature					
	L	J	I	L	S	I	J	P	O
				° F.	° F.	° F.	° F.	° F.	° F.
Start.....	13	14	13	98.4	98.4	98.2	98.2	98.6	98.6
End of fourth.....	26	20	22	98.2	97.4	98.4	97.8	98.6	98.6
End of sixth.....	72	52	55	96.8	97.0	97.2	97.0	97.4	97.2

It will be noted that the maximum carbon dioxide of tests 8, 14, and 20 was 5.6, 5.7, and 5.8 per cent, respectively, the differences being within the limits of error. The respective figures for oxygen were 16.1, 15.4, and 14.2 per cent, showing relatively small differences, but which might be significant in this low range.

The physiological effects: As in the previous tests the first noticeable effects on breathing on active exertion were generally reported at a time corresponding to approximately a 2 per cent concentration of carbon dioxide. Although more marked at 3 per cent, the subjects were still not conscious of any particular effort in breathing except on exertion. All noted a pronounced increase in depth of breathing at approximately 4 per cent, the stage of panting virtually setting in at this time.

The physiological effects of these three tests were severe; so much so that it was not considered advisable to expose the subjects to percentages of carbon dioxide in excess of 5.8 per cent. In fact, during the last hour of all three of these tests all subjects, with the exception of H complained of dyspnea in addition to the exhaustion from the severe panting. The two observers entering in the last hour of test No. 8 became so dyspneic that they were unable to make physiological observations and it was necessary to discontinue the experiment. Subjects P and L were seized with such dizziness, nausea, and dyspnea during the seventh hour of test No. 20 that it was necessary to release them from the chamber.

The majority of the subjects showed a tendency to cyanosis toward the close of these tests. A burning sensation in the throat and paroxysms of coughing were complained of in a few instances. Headache was not a constant symptom, but the bulk of the men reported this symptom during the last two hours, persisting after the tests for periods varying from 1 to 3 hours. It was frequently associated with slight nausea.

Chilly sensations were generally reported and almost constantly associated in the last few hours with a subnormal body temperature. For instance, in test No. 20 the final body temperature varied from 96.8° to 97.4° F.; in test No. 14 from 97.2° to 97.6° F. An inspection of the tables brings out the fact that the air temperature and relative humidity were apparently not conducive to any chilling of the body surfaces, even under the existing conditions of very active air movement within the chamber. The final temperature in the three experiments varied from 72° to 77° F.; the final relative humidity from 76 to 77.

As indicated in previous tests, the data for pulse rates apparently have no significance. Contrasting the rates at the start and close of the various tests, there is no consistent trend in any particular direction.

The initial and final respiration rates per minute: In test 8 we find the increases varying from 3 with subject I to 10 with J; in test 14 from 3 with J to 11 with L; in test 20 from 6 with J to 37 with L. The respective average increases are 6, 5½, and 15 for tests 8, 14, and 20, respectively.

The expiration volume per minute: In test 14 the expiration volume per minute at the start varied from 11 to 14 liters; at the end of the sixth hour with carbon dioxide at 4.8 per cent and oxygen at 17.1 per cent from 26 to 38 liters; the average increase being 200 per cent. On the other hand, in test 20 at the end of the sixth hour with carbon dioxide at 4.8 per cent, but with oxygen at 15.9 per cent, the average increase was 46 liters, or 353 per cent. It is not believed that the differences in oxygen concentration were sufficient to induce such a marked difference in respiratory response. There was considerable variation between subjects as was noted in all of the physiological observations.

Impression: The uniform impression of all subjects and observers in the three tests under consideration was that test 20 was unquestionably the most severe; both with reference to immediate and subsequent effects. The respiratory rates and minute expiration volumes point in this direction. The oxygen was conspicuously low in test 20, falling to a minimum of 14.2 per cent, the lowest figure ob-

tained except in the soda lime tests, to be later discussed. This was, in all probability, the chief factor in the severity of the physiological effects.

(2) *Tests with oxygen supply.*—In this group of experiments definite volumes of oxygen were supplied to the respiration chamber to offset the respiratory consumption.

(a) *With maximum carbon dioxide at 4.3 to 4.7 per cent and minimum oxygen at 18.5 to 23.4 per cent (tests 2, 3, 5, and 6):*

The data of these tests are tabulated in Tables 7 to 10, inclusive.

TABLE 7

Oxygen: Introduced into chamber, 75 liters per hour throughout test.  
Carbon dioxide: None.  
Duration: 8¼ hours.  
Subjects: K, C, E, F.

[Test No. 2]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature, average	Relative humidity	Pulse per minute				Respiration per minute			
					K	C	F	E*	K	C	F	E
					Per cent	Per cent	° F.	Per cent				
Start.....	0.1	20.9	75	45	80	72	70	68	14	10	14	14
End of fourth.....	1.6	18.7	72	67	70	76	71	73	14	10	12	16
End of sixth.....	3.0	18.4	68	70	69	71	69	71	17	11	14	17
End of eighth.....	3.7	18.3	68	80	68	71	67	67	17	13	14	14
End of tenth.....	4.6	18.2	68	70	66	70	67	70	20	13	19	22

Time, hours	Blood pressure							
	K		C		E		F	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
End of tenth.....	112	80	134	92	156	56	128	82

TABLE 8

Oxygen: Introduced into chamber, 100 liters per hour throughout test.  
Carbon dioxide: None.  
Duration: 10 hours.  
Subjects: K, C, F, E.

[Test No. 3]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature, average	Relative humidity	Pulse per minute				Respiration per minute			
					K	C	F	E	K	C	F	E
					Per cent	Per cent	° F.	Per cent				
Start.....	0.1	20.7	73	59	83	71	57	76	15	10	12	14
End of fourth.....	1.8	20.8	68	64	76	63	61	82	9	9	14	14
End of sixth.....	2.7	20.2	66	64	69	73	54	80	17	14	11	20
End of eighth.....	3.7	20.1	66	65	77	75	55	69	23	16	18	22
End of tenth.....	4.3	19.9	68	70	69	70	59	68	-----	-----	-----	-----

TABLE 9

Oxygen: Introduced into chamber, 200 liters per hour throughout test.  
Carbon dioxide: None.  
Duration: 10 hours.  
Subjects: B, E, F, D.

[Test No. 5]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature, average	Relative humidity	Pulse per minute				Respiration per minute				
					B	E	F	D	B	E	F	D	
	<i>Per cent</i>	<i>Per cent</i>	<i>° F.</i>	<i>Per cent</i>									
Start.....	0.0	21.7	75		76	94	84	74	13	13	17	15	
End of fourth.....	2.1	21.0	70	66	60	85	71	72	13	15	14	15	
End of sixth.....	2.7	21.8	70	75	68	80	69	73	13	16	13	15	
End of eighth.....	3.7	22.0	70	68	78	67	75	71	12	19	17	15	
End of tenth.....	4.7	23.4	72	72	67	72	60	69	17	20	17	17	

TABLE 10

Oxygen: Introduced into chamber, 200 liters per hour throughout test.  
Carbon dioxide: None.  
Duration: 10¼ hours.  
Subjects: B, K, D, E.

[Test No. 6]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature, average	Relative humidity	Pulse per minute				Respiration per minute				
					B	K	D	E	B	K	D	E	
	<i>Per cent</i>	<i>Per cent</i>	<i>° F.</i>	<i>Per cent</i>									
Start.....	0.3	20.2	75	73	72	80	83	84	13	14	12	13	
End of fourth.....	2.0	21.1	77	82	63	72	71	73	11	16	15	16	
End of sixth.....	2.9	21.4	75	75	61	78	71	77	13	18	19	18	
End of eighth.....	3.1	21.5	75	68	58	84	67	67	11	20	18	23	
End of tenth.....	4.7	21.5	75	72	61	64	72	73	14	22	17	18	

Oxygen was supplied in total volumes varying from approximately 750 to 2,000 liters in these tests. The final oxygen varied from 18.3 to 23.4 per cent.

The physiological effects of these tests will be compared with the findings from tests 1 and 15 with approximately the same final percentage of carbon dioxide but in which no oxygen was supplied.

The physiological effects: Considering tests 2, 3, 5, and 6 as a group, it was the general impression of the subjects that the situation was essentially similar to that in tests 1 and 15. In the opinion of the writer as an observer in all of the tests, there was somewhat less depression and the incidence of headaches was reduced. However, there was no clear-cut difference. It must be remembered that individuals vary in their physiological reactions from day to day. This was definitely the case with certain of the subjects in different tests in which the concentration of carbon dioxide and oxygen was essentially the same. The rate of progression of depth of breathing



showed generally the same trend with and without supplied oxygen. The respiration was no more labored in one set of experiments than in the other.

The average increase in the final respiration rate for tests 1 and 15 was 4 per minute; for tests 2, 3, 5, and 6 it was 5 per minute, a negligible difference. The pulse rate for the first set of tests showed an average increase of 2 each for tests 1 and 15. For the second set the pulse rate showed an average decrease of 4, 5, 15, and 12 for tests 2, 3, 5, and 6, respectively. In the experiments with high oxygen there appeared to be a tendency to slowing of the pulse.

The interpretation of the data for blood pressure will be discussed at another place.

Conclusion: At a concentration of approximately 4.7 per cent of carbon dioxide the physiological effects were essentially similar, whether associated with an oxygen of 15.5 per cent or of 18 to 23 per cent.

(b) *With maximum carbon dioxide at 5.7 per cent and minimum oxygen at 18.5 to 21.9 per cent (tests 4, 9, 10, 16, and 24):*

The data of these tests are tabulated in Tables 11 to 15, inclusive.

TABLE 11

Oxygen: Introduced into chamber, 100 liters per hour throughout test.  
Carbon dioxide: None.  
Duration: 10 hours.  
Subjects: D, C, F, E.

[Test No. 4]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature average	Relative humidity	Pulse per minute				Respiration per minute			
					D	C	F	E	D	C	F	E
Start.....	0.2	20.3	73	59	63	65	70	79	11	8	10	15
End of fourth.....	2.1	20.7	72	75	66	71	70	75	14	10	14	7
End of sixth.....	3.5	20.1	66	70	63	79	64	63	16	11	17	14
End of eighth.....	4.0	20.3	68	80	61	69	65	75	27	11	28	23
End of tenth.....	5.7	18.5	68	80	63	71	67	71	32	15	35	27

Time, hours	Blood pressure							
	D		C		F		E	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
Start.....	125	83	126	70	124	76	110	80
End of tenth.....	144	92	140	76	144	78	116	86

TABLE 12

Carbon dioxide: Introduced into chamber, 260 liters.  
 Oxygen: Introduced into chamber, 1,618 liters.  
 Duration: 8½ hours.  
 Subjects: B, I, H, J.

[Test No. 9]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature, average	Relative humidity	Pulse per minute				Respiration per minute				Inspiration, liters per minute			
					B	I	H	J	B	I	H	J	B	I	H	J
Start.....	Per cent 0.0	Per cent 20.9	° F. 81	Per cent 42	83	78	84	76	15	16	11	17	11	18	13	19
End of fourth.....	3.5	21.3	70	71	60	82	78	78	12	18	18	14	17	15	16	20
End of sixth.....	4.3	21.1	72	80	63	81	78	77	14	19	11	14	21	23	21	31
End of eighth.....	5.5	20.9	72	60	70	77	78	75	17	18	16	16	30	29	31	34

Blood pressure

Time, hours	B		I		H		J	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
Start.....	112	72	109	51	113	69	116	76
End of eighth.....	114	82	138	82	120	78	112	74

TABLE 13

Carbon dioxide: Introduced into chamber, 260 liters.  
 Oxygen: Introduced into chamber, 1,617 liters.  
 Duration: 8½ hours.  
 Subjects: B, J, H, S.

[Test No. 10]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temperature, average	Relative humidity	Pulse per minute				Respiration per minute			
					B	J	H	S	B	J	H	S
Start.....	Per cent 0.0	Per cent 20.9	° F. 68	Per cent 58	81	75	84	94	13	12	17	20
End of fourth.....	3.5	21.1	72	71	64	76	82	76	14	15	17	24
End of sixth.....	4.7	21.1	73	71	72	82	78	82	18	20	19	22
End of eighth.....	5.8	21.2	77	77	68	74	74	74	20	19	23	28

Time, hours	Inspiration, liters per minute				Body temperature			
	B	J	H	S	B	J	H	S
Start.....	14	18	18	17	° F.	° F.	° F.	° F.
End of second.....	27	23	27	10				
End of fourth.....	29	26	23	19				
End of sixth.....	31	40	38	32	97.4	96.4	97.4	97.4

Blood pressure

Time, hours	B		J		H		S	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
Start.....	112	72	116	76	113	69	109	70
End of eighth.....	116	82	108	66	104	70	130	78

TABLE 14

Carbon dioxide: Introduced into chamber, 390 liters.  
 Oxygen: Introduced into chamber, 1,696 liters.  
 Duration: 8½ hours.  
 Subjects: B, L, S, J.

[Test No. 16]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temper- ature average	Rela- tive hu- midity	Pulse per minute				Respiration per minute				
					B	L	S	J	B	L	S	J	
	<i>Per cent</i>	<i>Per cent</i>	<i>° F.</i>	<i>Per cent</i>									
Start.....	0.0	20.9	75	77	84	106	102	75	13	10	16	14	
End of fourth.....	4.0	21.5	73	86	72	82	72	58	16	13	16	15	
End of sixth.....	4.6	21.9	75	82	67	78	72	66	19	17	19	19	
End of eighth.....	5.7	21.8	79	-----	66	80	-----	58	21	25	-----	18	

Time, hours	Expiration, liters per minute				Body temperature			
	B	L	S	J	B	L	S	J
					<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>
Start.....	11	7.8	11	16	98	98.8	98.4	98.7
End of fourth.....	16	26	26	25	98	98.4	98	97.8
End of sixth.....	17	30	32	34	97.2	98	97.8	97.6
End of eighth.....	39	58	39	62	97.6	97	-----	97.2

Time, hours	Blood pressure							
	B		L		S		J	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
Start.....	111	70	115	71	114	70	112	78
End of eighth.....	120	68	128	78	118	76	127	85

TABLE 15

Carbon dioxide: Introduced into chamber, 195 liters.  
 Oxygen: Introduced into chamber, 1,950 liters.  
 Duration: 8½ hours.  
 Subjects: L, I, J, S, O, P.

[Test No. 24]

Time, hours	Carbon dioxide	O <sub>2</sub>	Temper- ature, average	Rela- tive hu- midity	Pulse per minute						Respiration per minute					
					L	I	J	S	O	P	L	I	J	S		
	<i>Per cent</i>	<i>Per cent</i>	<i>° F.</i>	<i>Per cent</i>												
Start.....	0.0	20.9	80	73	90	83	72	80	62	72						
End of fourth.....	4.1	20.8	75	73	90	76	85	72	56	70	36	27	19	26		
End of sixth.....	4.9	20.3	77	82	86	73	70	74	57	80	31	29	20	30		
End of eighth.....	5.8	21.3	77	86												

Time, hours	Expiration, liters per minute				Body temperature					
	L	I	J	S	L	I	J	S	O	P
					<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>
Start.....	20	25	19	13	98.6	99.2	98	98.2	97.4	97.6
End of fourth.....	49	23	27	23	97.6	97.6	98.4	98.2	-----	-----
End of sixth.....	60	40	35	35	97.2	97.2	97.2	96.8	96.6	97.2

TABLE 15—Continued

Time, hours	Blood pressure							
	L		I		J		S	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
Start.....	115	70	118	60	120	80	125	90
End of sixth.....	120	80	122	80	120	90	130	90

The physiological effects of these tests with approximately normal oxygen will be compared with another series in which no oxygen was supplied, the carbon dioxide concentration, however, being approximately as high. These tests are Nos. 13, 8, 14, and 20, and the data are contained in Tables 3, 4, 5, and 6, respectively. The final carbon dioxide in this series varied from 5.2 to 5.8 per cent; the oxygen from 16.1 to 14.2 per cent. The comparative physiological results of the two groups, one designated as the high-oxygen and the other as the low-oxygen group will now be discussed.

**The respiration rate:** The average final increase per minute of all subjects was computed. With the low-oxygen group it varied from 4 to 18; with the high-oxygen group from 4 to 24. There appeared to be a trend to a slightly higher rate with the high-oxygen group, but the data were not sufficient on which to base a definite conclusion. It is clear, however, that the maintenance of a higher oxygen did not reduce the rate of respiratory response.

**The pulse rate:** The final data were decidedly divergent with the low-oxygen group, varying from a decrease of 7 to an increase of 11. With the high group there was a decrease in rate for practically all subjects, varying from 1 to 23, with a general average drop of 9. The differences are not sufficiently consistent to be significant.

**The expiration volume per minute:** These data are of particular interest. It will be noted that the inspiration and not the expiration volume was determined with tests 9 and 10, but one would not differ materially from the other. With tests 13 and 14 of the low-oxygen group the final total increase in the expiration volume was 235 and 294 per cent, respectively. With tests 9, 10, and 16 of the high-oxygen group the respective increases were 106, 106, and 330 per cent. Test 20 of the low-oxygen group at the sixth hour showed a rise of 356 per cent, while test 24 of the high group at the same hour indicated an increase of only 121 per cent. With a single exception there is a definite tendency to a reduced respiratory response with the high-oxygen group. Additional tests, however, would be essential to justify a final conclusion.

The final body temperature: As already indicated in previous tests, this was almost invariably subnormal in both the high and low groups, the final readings varying from 96.4° to 97.6° F. The question arises whether these thermal disturbances were associated with some factor other than the changes in carbon dioxide.

Certain tests were carried out resulting in a condition of low oxygen and comparatively low CO<sub>2</sub>. The details are not presented here, as the object was to determine the absorptive efficiency of soda lime for CO<sub>2</sub>. In one test of 10 hours CO<sub>2</sub> reached only 2.3 per cent with oxygen at 15.6 per cent; in two others CO<sub>2</sub> showed a maximum of 3 per cent with oxygen at 15.1 per cent and 14.5 per cent. In none of these tests were subnormal body temperatures observed. It appears clear that high CO<sub>2</sub> was a causative factor in the experiments with high CO<sub>2</sub>.

As a further control study of the situation three subjects were sealed up in the respiration chamber for eight hours under the usual routine of the tests, with the exception that air was metered into and through the chamber at a rate sufficient to prevent a rise of CO<sub>2</sub> above 1.7 per cent in one test and 1.6 per cent in another. The usual temperature and relative humidity conditions of the tests prevailed. In the two tests the final body temperatures were normal throughout with a single exception. The evidence was again strongly in favor of a specific action of high carbon dioxide on the thermal regulating system of the body.

Blood pressure: In test 9 of the high group the rise or fall of systolic pressure is contrasted with 8 of the low group. In test 9 it varied in the various subjects from minus 4 to plus 21; in test 8 from minus 7 to plus 13. Comparing test 16 with test 13 we find that the variation in the former was plus 8 to plus 16; in the latter group from minus 2 to plus 27. There was no consistent variation between the two groups.

The subjective effects: The experimental subjects were not aware of the oxygen conditions of the tests, thus eliminating the psychological factor. It was the general impression of both the observers and the subjects that the experiments of the high oxygen group were somewhat less severe from the subjective standpoint. The incidence of headache and particularly dyspnea appeared to be less and the feeling of exhaustion a little less severe both during and subsequent to the tests. In the opinion of the writer, however, the differences were not uniformly distinct and striking. It was the definite impression of all observers entering the respiration chamber for the final hour of the tests that the dyspnea incident to the low-oxygen group was either absent or slight in the high-oxygen group. On the other hand the panting did not appear less labored in the latter group.

The maintenance of high oxygen did not relieve the situation to the extent that exposure to increased concentrations of carbon dioxide was considered justified.

The following question arises in reference to the dyspnea observed in the low-oxygen group of tests: To what extent, if any, does the low oxygen concentration contribute to the dyspnea? In two of the soda lime tests initial symptoms of oxygen depletion occurred in all subjects at approximately 13.4 per cent of oxygen, the  $\text{CO}_2$  percentage being comparatively low, i. e., 3.2 per cent. The symptoms consisted of giddiness which increased on movement, and headache. On the other hand, slightly higher concentrations of oxygen of 14.6 to 17 per cent with 2.5 to 2.8 per cent of  $\text{CO}_2$  were practically without conscious physiological effect. It is, therefore, estimated that signs of oxygen depletion must have first appeared at about 14 per cent of oxygen, or slightly under that figure.

The minute-expiration volumes were not measured in this group of tests with low oxygen and low  $\text{CO}_2$ . Hyperpnea was not apparent and, if present, not sufficient to induce conscious effects. This was in marked contrast with the influence on breathing of high  $\text{CO}_2$  whether associated with high or low oxygen.

In the experiments of the low oxygen low  $\text{CO}_2$  group the subjects were not conscious of dyspnea. On the other hand, as already pointed out, with oxygen concentrations of this order of magnitude associated with high  $\text{CO}_2$  moderate dyspnea resulted, and was prevented or lessened by high oxygen. In other words, a certain grade of dyspnea was induced by a combination of low oxygen and high  $\text{CO}_2$  not found if the  $\text{CO}_2$  was low or the oxygen was high.

The conclusion is reached that a normal concentration of oxygen may relieve to a limited degree the subjective distress incident to high percentages of  $\text{CO}_2$  and low concentrations of oxygen. Oxygen should be supplied but it can not be regarded as having an antidotal action on the effects of  $\text{CO}_2$ . In fact, it is considered doubtful if normal oxygen would be of any benefit if  $\text{CO}_2$  exceeded 6 to 7 per cent. Naturally, if the oxygen fell below 14 per cent as a result of rebreathing the air, the supply of oxygen would prevent symptoms of oxygen depletion being added to those of high  $\text{CO}_2$ . The combined effect of low oxygen and high  $\text{CO}_2$  appears to be relieved by the addition of oxygen when the vitiation of the air is from 4 to 6 per cent of  $\text{CO}_2$ .

Studies in literature: Certain researches have been carried out with a bearing on the influence of high oxygen on the effects of excess of  $\text{CO}_2$ . Hough (1) in 1910 reported that on rebreathing from a confined atmosphere with 60 to 80 per cent of oxygen the respiratory rate and minute volumes of air breathed were distinctly lower than when ordinary air was respired. The increase of oxygen

apparently reduced the sensitivity of the respiratory center to increase of  $\text{CO}_2$ .

Haldane and Priestley (2) in 1902 pointed out that variations in the oxygen concentration of the inspired air could be considerable without any immediate effect on the activity of the respiratory center. Benedict and Higgins (3) found that the breathing of pure oxygen produced no change in the character, depth, or frequency of the respiration.

Lindhard (4) in 1905 investigated the same subject with a different technique. He found that the ventilatory response to concentrations of  $\text{CO}_2$  around 6 per cent was only about half as great with oxygen at 96 per cent as against 20 per cent. In direct conflict with Lindhard's conclusions are those of Campbell, Douglas, Haldane, and Hobson (5) in 1913. They found that Lindhard's technique was apparently defective. They inspired air of 6 per cent  $\text{CO}_2$  with the oxygen varying from 19.8 to 64.2 per cent. It was concluded on the basis of their own work that the effect of high concentrations of  $\text{CO}_2$  were the same under widely varying oxygen concentrations. Their conclusions have been generally accepted since that time.

They also emphasize that there is much practical experience in deep diving and the use of rescue apparatus to indicate that the effects of high  $\text{CO}_2$  are not modified by oxygen. Haldane in connection with his deep diving investigations has frequently verified the fact that hyperpnea is just as great whether oxygen is normal or high.

Davies, Brow, and Binger (6) in 1925 also studied the influence of high oxygen at approximately 90 per cent on the respiratory response to  $\text{CO}_2$ . They stated that the total pulmonary ventilation was slightly greater at high oxygen than at normal oxygen in the inspired air. On the other hand the increase was considered as being too slight to have any great significance.

Haldane and Smith (7) in 1892 and Douglas and Haldane (8) in 1909 showed that the oxygen in inspired air may not only be increased but considerably reduced without affecting in the slightest the hyperpnea induced by  $\text{CO}_2$ , provided the increase of  $\text{CO}_2$  is more or less proportional to the diminution of oxygen.

Schneider and Truedell (9) in 1922 studied the normal curves of circulatory and respiratory responses to gradual increase of  $\text{CO}_2$  in the inspired air up to an average of 7.3 per cent for short periods. In one series the oxygen was kept at approximately normal; in another series the conditions were paralleled except that the oxygen was gradually exhausted. The two groups reacted very much alike, the results being against any evidence of the maintenance of normal oxygen relieving or counteracting the effects of excess of  $\text{CO}_2$ .

Meakins and Priestley (10) in 1919 reported that the maximum increase of lung ventilation was obtained when an excess of  $\text{CO}_2$  and decrease of oxygen were both present. The respiring of 6.5 per cent of  $\text{CO}_2$  with 68 per cent of oxygen produced a marked immediate increase in both the depth and rate of breathing. When the oxygen was low with excess of  $\text{CO}_2$  there was more marked distress with cyanosis.

Haldane and Smith (ibid) found the breaking point on rebreathing from a closed space to be 10 per cent of  $\text{CO}_2$  whether air or pure oxygen were breathed.

In the tests of the present paper the circulatory and respiratory responses were more gradually adapted to the rising percentages of  $\text{CO}_2$  for the reason that practically all of the experiments in the literature have been of short duration. On the other hand a greater degree of fatigue was involved from the very protracted exposures. The effect of the maintenance of normal oxygen was contrasted with the responses to  $\text{CO}_2$  when the oxygen was gradually exhausted in proportion to the rise of  $\text{CO}_2$ .

It is felt that the results are not opposed to those of the literature. The supply of normal oxygen relieved the subjective distress resulting from the combination of low oxygen in proportion to  $\text{CO}_2$  of 5 to 6 per cent and the minute-expiration volume tended to be reduced. It is believed, however, that this result was due to the prevention of oxygen deficiency and not to any specific action on the responses to high  $\text{CO}_2$ ; although the subjective distress to this extent was not found with low oxygen alone or high  $\text{CO}_2$  with high oxygen. There is no evidence that high oxygen would offset the effects of high  $\text{CO}_2$  as such.

(3) *The effect of high carbon dioxide on physical efficiency.*—This is an important consideration in connection with the personnel of submarines under conditions of a disaster or operations in time of war.

It was decided to determine the Schneider index as a method for the measurement of the fatigue resulting from protracted exposure to high  $\text{CO}_2$ . The action on blood pressure alone, however, will be first considered.

(a) *Blood pressure in relation to high carbon dioxide (tests Nos. 8, 13, 4, 9, 10, 16, and 24):*

Blood pressure was recorded just prior to the beginning and again within one-half hour of the close of the test. The data are assembled in Table 16.



TABLE 16.—Blood pressure

	CO <sub>2</sub>	O <sub>2</sub>	Systolic and diastolic			
			B	L	H	S
<b>Test No. 13:</b>	<i>Per cent</i>	<i>Per cent</i>				
Initial.....	0.0	20.9	112/72	116/70	113/69	116/76
Final.....	5.2	15.8	117/78	128/81	140/84	114/64
			H	I	J	K
<b>Test No. 8:</b>						
Initial.....	0.0	20.9	113/69	109/51	116/76	100/67
Final.....	5.7	18.1	112/74	122/68	110/68	106/74
			D	C	F	E
<b>Test No. 4:</b>						
Initial.....	0.2	20.6	125/83	126/70	124/76	110/80
Final.....	5.7	18.5	144/92	140/76	144/78	116/86
			B	I	H	J
<b>Test No. 9:</b>						
Initial.....	0.0	20.9	112/72	109/51	113/69	116/76
Final.....	5.5	20.9	114/82	138/82	120/78	112/74
			B	J	H	S
<b>Test No. 10:</b>						
Initial.....	0.0	20.9	112/72	116/76	113/69	109/70
Final.....	5.8	21.2	116/68	108/66	104/70	130/78
			B	L	S	J
<b>Test No. 16:</b>						
Initial.....	0.0	20.9	111/70	115/71	114/70	112/78
Final.....	5.7	21.2	120/68	128/78	118/76	127/85
			L	I	J	S
<b>Test No. 24:</b>						
Initial.....	0.0	20.9	115/70	118/60	120/80	125/80
Final.....	5.7	21.3	120/80	122/80	120/90	130/90

The range of rise or fall of systolic and diastolic pressure in millimeters of mercury is grouped as follows, representing 2 to 5 tests with each subject:

Subject	Systolic	Diastolic
B.....	Plus 2 to plus 9; average, plus 5.	Minus 4 to plus 10; average, plus 3.
L.....	Plus 5 to plus 13; average, plus 10.	Plus 7 to plus 10; average, plus 9.
H.....	Minus 9 to plus 27; average, plus 6.	Plus 1 to plus 9; average, plus 5.
S.....	Minus 2 to plus 21; average, plus 7.	Minus 12 to plus 10; average, plus 3.
I.....	Plus 4 to plus 29; average, plus 15.	Plus 7 to plus 31; average, plus 19.
J.....	Minus 8 to plus 15; average, 0.	Minus 8 to plus 10; average, 0.

In addition to the above, one test only was carried out with subjects K, D, C, E, and F; the systolic data showing a rise varying from 6 to 20 with an average of 13; the diastolic increasing from 2 to 9 with an average of 6.

The general average for all subjects of all the tests was a rise of systolic pressure of 8 and of diastolic pressure of 6 with CO<sub>2</sub> varying from 4.8 to 5.8 per cent. It will be noted that the variations were considerable between individuals or even with the same subject, presenting even a rise at one time and a decrease at another. The trend was toward a rise of both systolic and diastolic pressures, although slight at this concentration of CO<sub>2</sub>.

(b) *The Schneider index (tests Nos. 8, 9, 10, and 13):*

The data for the Schneider index were taken within one hour of the start and one hour of the end of the test. They are presented in Table 17:

TABLE 17.—*Schneider index*

	CO <sub>2</sub>	O <sub>2</sub>	Index			
			B	L	H	I
Test No. 13:	<i>Per cent</i>	<i>Per cent</i>				
Initial.....	0.0	20.9	6	11	8	10
Final.....	5.2	15.8	9	14	7	13
			H	I	J	K
Test No. 8:						
Initial.....	0.0	20.9	2	6	7	10
Final.....	5.7	16.1	10	12	11	14
			B	I	H	J
Test No. 9:						
Initial.....	0.0	20.9	6	7	1	7
Final.....	5.5	20.9	13	12	9	13
			B	J	H	S
Test No. 10:						
Initial.....	0.0	20.9	6	7	5	12
Final.....	5.8	21.2	12	8	10	13

Carbon dioxide concentration of 5.5 to 5.8 per cent with oxygen at 20.9 to 21.2 per cent: The scores were determined for subjects B, I, H, S, and J, and showed an increase in all instances varying from 1 to 8 with an average rise of 4.9.

Carbon dioxide concentration of 5.2 to 5.7 per cent with oxygen at 15.8 to 16.1 per cent: The scores were determined for subjects B, H, I, J, K, and L. With a single exception all scores were increased, the rises fluctuating between 3 and 8 with a general average of 3.8 for the low oxygen group in contrast to 4.9 for the high oxygen series. The general average increase of all scores for all experiments was 4.3.

The final scores for all subjects varied between 7 and 14 with an average of 11.3; the initial scores from 1 to 11, averaging 7.

The Schneider index has to do with observations on man in what may be regarded as the basal condition under ordinary atmospheric conditions. Hence the use of pulse rate and blood pressure during exposure to an excess of CO<sub>2</sub> or immediately after exposure, would be merely a record of the effects of CO<sub>2</sub> on circulatory factors. It is therefore realized that in the present experiments the index is being used for a purpose other than that for which it was intended.

The increase in the indices indicates a marked degree of stimulation of the cardiovascular system. The cardiovascular reserve was adequate to meet this grade of stimulation. It does not, however, signify an improvement in physical efficiency.

(4) *The effect of high carbon dioxide on mental efficiency:*

This question is of particular interest in connection with the operating efficiency of the personnel of submarines. Of special importance would be the effect on the ability of officer personnel to exercise sound judgment and make quick decisions. It was essential in these experiments to use tests to measure the ability of the men to do mental work, to do it in the minimum time and with the least expenditure of energy. In order to carry them out it was necessary for the men to control their emotions and maintain nervous stability under conditions of marked fatigue and discomfort.

The mental efficiency aspects were studied in tests 20 and 24.

(a) *Army Alpha intelligence tests.*—A new Alpha test was given at each indicated period.

TABLE 18A.—*Army Alpha scores corrected for practice effect*

Subject	Test No. 20			Test No. 24			
	Start	End of fourth hour: CO <sub>2</sub> , 2.9 per cent; O <sub>2</sub> , 17.6 per cent	End of sixth hour: CO <sub>2</sub> , 4.8 per cent; O <sub>2</sub> , 15.9 per cent	End of eighth hour: CO <sub>2</sub> , 5.8 per cent; O <sub>2</sub> , 14.2 per cent	Start	End of fifth hour: CO <sub>2</sub> , 4.5 per cent; O <sub>2</sub> , 20.6 per cent	End of seventh hour: CO <sub>2</sub> , 5.3 per cent; O <sub>2</sub> , 20.5 per cent
L.....	112	108	102	-----	119	110	78
P.....	202	185	188	-----	204	196	187
I.....	72	85	85	82	91	112	87
J.....	116	110	115	101	131	128	126
S.....	70	57	81	61	84	93	75

It will be noted in test 20 the intelligence tests were carried out at the end of the fourth, sixth, and eighth hours with carbon dioxide at 2.9, 4.8, and 5.8 per cent, respectively; in test 24 at the end of the fifth and seventh hours with carbon dioxide at 4.5 per cent and 5.3 per cent, respectively.

The data appear to show definitely that there was only a very little falling off in the scores as the tests proceeded. This is even true

with reference to the score for the periods associated with 5.3 and 5.8 per cent carbon dioxide when respiratory distress and dyspnea were present. Essentially the same trend was shown in tests 20 and 24. There was some variation in the degree of decrease, but the difference was slight.

The data were fully discussed with Doctor Moss, of George Washington University, and his opinion was concurred in that the variations were, in general, negligible. The conclusion is drawn that there was sufficient reserve from the psychological standpoint to meet the emergency. If the situation here presented were sufficiently prolonged a breakdown would undoubtedly follow.

(b) *Cancellation tests.*—

TABLE 18B.—*Score of cancellation test*

Subject	Test No. 20: Cancellation of 300 numbers = 100 per cent			Test No. 24: Cancellation of 200 numbers = 100 per cent		
	Start: CO <sub>2</sub> , 0.0 per cent; O <sub>2</sub> , 20.9 per cent	End of fourth hour: CO <sub>2</sub> , 2.9 per cent; O <sub>2</sub> , 17.6 per cent	End of sixth hour: CO <sub>2</sub> , 4.8 per cent; O <sub>2</sub> , 15.9 per cent	Start: CO <sub>2</sub> , 0.0 per cent; O <sub>2</sub> , 20.9 per cent	End of fourth hour: CO <sub>2</sub> , 4.1 per cent; O <sub>2</sub> , 20.8 per cent	End of seventh hour: CO <sub>2</sub> , 5.3 per cent; O <sub>2</sub> , 20.5 per cent
	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>
P.....	270—90.0	247.0—82.3	233—77.6	155.0—77.5	150.0—75.0	137.0—68.5
L.....	286—95.3	278.0—92.6	261—87.0	176.0—87.5	134.0—67.0	135.0—67.5
S.....	279—93.0	222.0—74.0	215—71.6	137.0—68.5	118.0—59.0	126.0—63.0
I.....	257—85.6	167.0—55.6	203—67.6	139.0—69.5	131.0—65.5	71.0—35.5
J.....	269—89.6	178.0—59.3	178—59.3	118.0—59.0	100.0—50.0	80.0—40.0
Average.....	272—90.6	218.6—72.6	218—72.6	144.8—72.4	126.6—63.3	109.8—54.9

There was more distinctive falling off with this type of test. For instance, in test 20 the normal scores ranged from 85.6 to 95.3 per cent; the finals at 4.8 per cent of carbon dioxide from 59.3 to 87 per cent. Even these reductions, however, with the possible exception of subject I, are not significant of any serious deterioration. Essentially the same trend was shown in test 24.

(c) *Arithmetic tests.*—

TABLE 18C.—*Scores of arithmetic test*

Subject	Test No. 24: Addition					
	Start: CO <sub>2</sub> , 0.0 per cent		End of fourth hour: CO <sub>2</sub> , 4.1 per cent		End of seventh hour: CO <sub>2</sub> , 5.3 per cent	
L.....	29		23		24	
I.....	21		26		23	
S.....	24		22		12	
J.....	11		8		12	
O.....	18		22		22	
Average score.....	20.6		20.2		18.6	
Average time.....	Min.	Sec.	Min.	Sec.	Min.	Sec.
	8	16	8	19	8	57

It will be noted that the scores in the arithmetic tests show a trend in general similar to those in the cancellation tests. The falling off does not indicate any marked mental fatigue; with certain individuals no decrease was shown.

(d) *Tests with the rebreather reactor apparatus.*—The subject was seated before a series of 14 stimulus lamps (2 candlepower) arranged in 2 rows of 7 each, with 2 similarly arranged rows of contact buttons, each surrounded by a washer. He was given a stylus with a hard rubber handle and metal tip. The observer, by means of a button board having 14 buttons corresponding to the 14 stimulus lamps, constantly flashed the lights in irregular order. The subject was directed to touch contact button before light went out, a green deck lamp lighting if correct, but if touching the washer a red error lamp would light. At the same time it was required that the subject adjust a motor kept continuously running to low speed with a foot pedal whenever high speed was indicated by the sound. The speed of the motor was varied by the observer. The test was continued for five minutes and the score computed on the basis of the percentage of error of contacts for the lights and changes in the motor speed out of the total number induced. The data were as follows:

TABLE 18D.—*Rebreather reactor apparatus*

Subject	Test No. 20			Test No. 24		
	Before test	End of sixth hour; CO <sub>2</sub> , 4.8 per cent; O <sub>2</sub> , 15.9 per cent	End of seventh hour; CO <sub>2</sub> , 5.3 per cent; O <sub>2</sub> , 15.05 per cent	Before test	End of fourth hour; CO <sub>2</sub> , 4.1 per cent; O <sub>2</sub> , 20.8 per cent	End of sixth hour; CO <sub>2</sub> , 4.9 per cent; O <sub>2</sub> , 20.3 per cent
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
O.....		30	28		44	
P.....		64	61			
L.....	67	82	70	67	70	81
J.....	78	63	77	78	58	60
S.....	63	78	68	63	58	56
I.....				43	47	50

Inspection of the data of both tests shows that increasing CO<sub>2</sub> up to 5.3 per cent did not materially lower the scores with the reactor apparatus. The general trend was the same with normal and with low oxygen. The functions of attention and muscular coordination did not show any significant changes as a result of exposure to high CO<sub>2</sub> sufficient to produce definite fatigue or even dyspnea.

*Summary.*—The scores of the intelligence tests showed little falling off until 5 per cent of CO<sub>2</sub> was reached, and then the decreases were not marked. The cancellation tests showed more marked decrease than did the intelligence tests and the mixed fundamentals in arithmetic showed a falling off in between the two. The tests indicated

comparatively little effect on mentality. There appeared to be considerable reserve to meet the strain imposed.

#### ACKNOWLEDGMENTS

Grateful acknowledgment is made of the valuable services and aid of the following: Mr. W. O. Scott, chemist, Edgewood Arsenal, who carried out the bulk of the air analyses of the experiments; Dr. F. A. Moss, associate professor of psychology, George Washington University, who supervised the mental efficiency tests and contributed valuable comment; Lieut. (Junior Grade) H. L. Ferguson, United States Navy, who supervised very efficiently the operating technique of the respiration chamber in many of the tests.

#### SUMMARY

The two objects of the present investigation were to determine the following: (1) The influence of high oxygen on the noxious effects of high carbon dioxide in submarines and (2) the effect of high concentrations of carbon dioxide on physical and mental efficiency. The term high oxygen in these experiments signifies the maintenance of approximately normal oxygen under conditions of rebreathing in a closed space.

The tests were conducted in a lead-lined respiration chamber of approximately 654 cubic feet capacity equipped with a cooling system whereby the temperature was controlled within comfort limits. Oxygen and carbon dioxide were supplied to the respiration chamber by means of an arrangement of recording wet meters and flow meters. The air analyses were determined with the Henderson-Orsat apparatus.

A total of 11 persons served as subjects of the tests, 4 being ordinarily designated for each experiment. The duration varied from  $5\frac{1}{3}$  to 12 hours, the average approximating 8 hours. The subjects were not aware of the air conditions, thus eliminating the psychological factor in connection with the effect of oxygen.

The following physiological data were determined at designated intervals: Pulse rate, respiration rate, the minute-expiration volume, the systolic and diastolic blood pressure, the body temperature and the Schneider index circulatory efficiency. Mental efficiency was tested by standard methods in certain of the experiments. The average temperature and relative humidity of the respiration chamber were recorded hourly.

A group of three tests was carried out in which the final carbon dioxide ranged from 4.7 to 5.2 per cent and the oxygen from 17.8 to 15.5 per cent. The oxygen was gradually reduced by rebreathing in proportion to the rise of carbon dioxide. No effect on breath-

ing was noted at 2 per cent carbon dioxide except on exertion. The subjects in general were not definitely conscious of increased respiratory effort at rest until approximately 3.5 per cent was reached.

At the close of the tests of this group slight depression, headache, chilliness, and fatigue were the chief symptoms. Body temperatures were subnormal. Breathing was labored but there was no feeling of actual dyspnea with carbon dioxide below 5 per cent. On the other hand with carbon dioxide at 5.2 per cent and oxygen at 15.8 per cent some shortness of breath at rest was reported. Labored breathing was more rapidly progressive above 4.5 per cent of carbon dioxide. The reaction of individuals to the air conditions varied considerably. The symptoms as described represent the majority of the subjects.

A group of four tests was conducted in which the final carbon dioxide varied from 4.3 to 4.7 per cent and oxygen from 18.2 to 23.4 per cent. Oxygen was supplied and the effects were contrasted with those of the above group in which the oxygen was allowed to diminish. The subjective symptoms of depression, headache, chilly sensations, and fatigue appeared to be somewhat less with the high oxygen group but the differences were not clear-cut. The depth and rate of breathing were not influenced.

In another group of three tests, oxygen not being supplied, carbon dioxide reached the higher concentrations of 5.6 to 5.8 per cent, the oxygen varying from 16.1 to 14.2 per cent. It was again observed that the subjects were not conscious of breathing effort at rest until approximately 3.5 per cent of carbon dioxide was reached. The stage of panting with subjects inactive was not particularly noticeable to observers under 4 per cent of carbon dioxide. The physiological effects in this group were so severe that it was not considered advisable to expose the subjects to higher concentrations—certainly not in excess of 6 per cent of carbon dioxide. One test was discontinued because of the severity of the symptoms and it was necessary to release certain subjects before the completion of other tests.

In addition to the depression, dyspnea and severe panting and headache, certain subjects developed dizziness and nausea. Headache persisted for one to three hours following the tests. There was a wide individual variation in the type and severity of symptoms. Chilly sensations were general with a final body temperature of 1° to 3° F. subnormal. Persistent fatigue subsequent to the tests was an outstanding symptom.

Still another group of five tests was conducted for comparison with the series just considered, oxygen being supplied. Final carbon dioxide ranged from 5.5 to 5.8 per cent and oxygen from 18.5 to 21.9 per cent.

It was the general impression of observer and subjects that such subjective effects as panting, dyspnea, headache, nausea, and chilliness and fatigue were somewhat less in the high oxygen group. The differences, however, were not striking, the more decided being reduction of dyspnea and less fatigue during and after the tests.

The objective data showed slight differences, except for the minute-expiration volume. The final pulse rate exhibited a tendency to fall in both high and low oxygen groups, but was more marked in the former. The rise in the respiratory rate showed a similar trend in both. The total increase in the minute-expiration volume in the low group for the three tests was 235, 294, and 356 per cent, respectively; for 4 tests of the high group, 106, 106, 330, and 121 per cent. This is evidence that with high oxygen the excitability of the respiratory center to carbon dioxide was materially reduced, but additional tests would be required to definitely settle the question.

The final body temperatures were 1° to 3° F. subnormal in both the high and low oxygen groups. In soda-lime absorption tests with essentially similar air conditions prevailing, except that carbon dioxide was low, subnormal body temperatures and sensations of chilliness were absent; this also being observed in control tests when ordinary air was supplied.

An air combination of low oxygen and low carbon dioxide was set up by utilizing soda lime. Initial symptoms of oxygen depletion were noted between 13 and 14 per cent of oxygen. No signs of oxygen deficiency or other reactions were manifest between 14 and 15 per cent of oxygen with low carbon dioxide. The train of symptoms associated with 5.8 per cent of carbon dioxide and 14 to 15 per cent of oxygen were severe and were lessened to a considerable extent when oxygen was kept at the normal level. It is concluded that this result was due to the prevention of the effects of oxygen shortage being added to those of excess of carbon dioxide and not to any antidotal influence on the action of carbon dioxide as such.

The Schneider index was of value in these tests only as indicating the stimulating effect of carbon dioxide on the cardiovascular system. With a single exception all subjects showed a rise in the final score at the high percentages of carbon dioxide, the average increase being 4.3. Under conditions of fatigue in ordinary air a decrease would have been looked for. The rise reflects the immense strain to which the heart and blood vessels were subjected.

Mental efficiency was tested under conditions of high carbon dioxide and low oxygen and high carbon dioxide and high oxygen. In one test the carbon dioxide reached 5.8 per cent and the oxygen was reduced to 14.2 per cent; in another the corresponding data were 5.3 and 20.5 per cent, respectively.



Army Alpha cancellation and addition tests were carried out at successive intervals. The functions of attention, memory, association and deduction were involved. Attention and motor coordination were also tested with a special type of apparatus described in the report. The results were striking in that the psychological effects were slight. While there was some falling off at 5.8 per cent carbon dioxide, still the scores were not materially lowered for any of the types of measurement employed. The conclusion is drawn that an excellent psychological reserve was maintained even though the subjects were working under conditions of toxic percentages of carbon dioxide.

It is felt that the personnel could carry on their usual submarine duties for a protracted period, if carbon dioxide did not exceed 5 per cent. Even at approximately 6 per cent of carbon dioxide the men could probably still carry on for a short time, the efficiency curve falling rather rapidly between 5.5 and 6 per cent. It is believed that the majority would be completely incapacitated above 6 per cent of carbon dioxide, which is regarded as the critical point. The supply of oxygen would improve physical and mental efficiency between 5 and 6 per cent of carbon dioxide but would not prolong it beyond the latter figure.

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#### TREATMENT FOR INFESTATIONS OF MAN WITH PARASITIC WORMS<sup>1</sup>

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In discussing treatments for infestations with parasitic worms within the limits of a lecture, it is necessary to speak all too briefly on many points, and it must be kept in mind that some things which may be said may be true and yet may call for an extended discussion, which can not be given here, to prevent them from being misunderstood or giving the effect of a half-truth. What is attempted here is to note the treatments which have been established as depend-

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<sup>1</sup> A lecture given at the Naval Medical School, Jan. 24, 1930.

able and more or less satisfactory, to note for certain parasitic worms that we have as yet no established treatments, and to call attention to certain general considerations which have been found to be of value in treating patients for verminous infestations.

#### ASCARIDS

##### CHENOPODIUM

The most effective drug for the removal of ascarids is oil of chenopodium. It is true that santonin is frequently said to be the most effective drug, but all of the critical experimentation of which I am aware, by far the greater part of the more critical clinical and laboratory studies in connection with the treatment of ascariasis in man, and most of the purely clinical studies which have come to my attention indicate that oil of chenopodium is distinctly superior to santonin for the removal of ascarids from man. In general it appears to be true that santonin will remove some ascarids and leave some in almost all cases where the drug is given once in a single therapeutic dose, or where the equivalent of a single therapeutic dose is given in two or three split doses over a period of 24 hours. On the other hand, oil of chenopodium will remove all of the ascarids present in a majority of the patients treated when the drug is given once in a therapeutic dose. The value of santonin in the treatment of ascariasis is its value as an alternative treatment where chenopodium is contraindicated, and in these cases santonin should be given in small doses daily over a period of several days, in order to develop a high efficacy in the removal of ascarids.

*Dose.*—The dose of chenopodium for an adult for the removal of ascarids is 1 c. c., and that for children is 1 drop per year of age. In practice there is considerable variation in the size of dose given, but in view of the high efficacy of oil of chenopodium and the toxicity of this drug and of other drugs for the removal of worms, it appears inadvisable to use a larger dose when a smaller will give satisfactory results in a majority of cases. In mass treatments the smallest effective dose is advisable for the reason that it is impossible to give adequate attention to contraindications, and in private practice it is advisable for the reason that one can repeat the treatment, if necessary, in those cases where the worms are not all removed by the first treatment. In dealing with anthelmintics considerations of safety should always be given as much attention as considerations of efficacy, and in cases of doubt or of conflict between safety and efficacy in the matter of a dose, safety should be the preferred consideration.

*Purgative.*—The purgative which I prefer for use with oil of chenopodium is castor oil given in doses of not less than one ounce immediately before the administration of the chenopodium. The question as to whether castor oil or salts is the better purgative for

use with chenopodium is a moot question, and in any given case one might decide in favor of the one or the other for various reasons. In my own experience I have come to the conclusion that castor oil is to be preferred for the reason that it coats the lining of the stomach and protects the mucosa of the stomach and intestines from the insult of the raw and undiluted chenopodium. On theoretical grounds, then, this would diminish the irritating action of the drug, distribute the insult over a larger area of mucosa, and by virtue of the fact that chenopodium is soluble in the castor oil would retard the absorption of the chenopodium and prolong the time of absorption. Never give a small dose of castor oil; give at least one ounce, and, if necessary, more.

It has been the experience of physicians in various parts of the world that in some places people will take castor oil without protest but object to salts, and that in some places people will take salts without protest but object to castor oil. In places where salts are preferred, one naturally uses salts. In this connection there is a tendency at present to substitute sodium sulphate for magnesium sulphate on the ground that sodium is less toxic than magnesium, and that magnesium has the further objection that it is antagonistic to calcium, and that this is a thing of importance in connection with blood calcium in patients treated with such drugs as carbon tetrachloride. In giving salts do not use a saturated solution as it is more dangerous and more nauseating than a dilute solution.

The saturated solution may be made up as a stock and diluted by the addition of twice this amount of water, the patient being given 90 c. c. of the salts solution containing the equivalent of 30 c. c. of saturated solution. The advantages in the use of salts are the rapid purgative action and the theoretical advantage, supported by some experimental evidence, that the salt action retards, and to a large extent prevents, the absorption of certain anthelmintics. Where salts are used as a purgative it is customary to give them an hour after the chenopodium, and in all cases where purgatives are administered as much as an hour after the administration of chenopodium, it is advisable to use salts instead of the slower acting castor oil.

As a routine procedure in connection with anthelmintic treatment the physician or nurse should ascertain at the end of four hours after giving the treatment whether the bowels have moved. If they have not moved at this time, salts should be given. At the end of eight hours if the bowels have not moved the patient should be given another dose of salts and an enema, and measures should be taken at this time to insure purgation. Purgation is the most important of the general measures for the safety of the patient and must be secured by whatever measures are necessary if serious disturbances and deaths are to be avoided. A rather large proportion of all

patients treated with any anthelmintic will complain of some or all of the following symptoms: Headache, dizziness, or nausea. These symptoms are due in part to the anthelmintic and in part to the purgative, and it is astonishing how rapidly these things clear up after a bowel movement. It is a reflection on the physician when a patient dies after the administration of an anthelmintic with a history of no bowel movement after many hours and no record of a serious attempt to secure purgation.

*Other measures.*—In connection with anthelmintics in general the patient should avoid alcohol, fats, cream, and oils other than castor oil during the day preceding treatment and the day of treatment. Olive oil is especially contraindicated in connection with chenopodium. The evening meal on the day before treatment should consist of liquids and the patient should fast overnight and until the bowels move. Fasting overnight is a regular procedure which does not leave the digestive tract and nervous system in an abnormal condition, and longer fasting upsets the patient and makes him more susceptible to the possible bad effects of anthelmintics. Coffee may be given at any time during the morning of treatment and appears to have a beneficial effect in stimulating the patient and in diminishing nausea and headache commonly associated with treatment and the postponement of the morning meal. Preliminary purgation the night before treatment appears to be unnecessary as a rule, and should be resorted to only in such special cases as those of patients who are constipated or for such special cases as the treatment for the removal of tapeworms.

*Action of drug.*—Chenopodium is constipating, is a gastrointestinal irritant, depresses the nervous system, and is said to be abortifacient, although Doran (1924) says that he has seen it used on dozens of pregnant women with no bad effects. It may cause temporary or, rarely, permanent deafness.

*Contraindications.*—The contraindications for chenopodium include gastroenteritis, acute or chronic alcoholism, chronic constipation (which calls for preliminary purgation), extreme youth or old age or debilitating conditions (which call for diminished doses), febrile conditions (which should be cleared up as a rule before anthelmintic treatment), and pregnancy. In spite of Doran's experience it would be advisable to take pregnancy seriously as a contraindication, and substitute santonin for chenopodium. In connection with pregnancy the drastic use of saturated salt solutions should be avoided.

#### SANTONIN

In the presence of contraindications for the use of chenopodium, especially hemorrhagic gastroenteritis or pregnancy, santonin should be used.

*Dose.*—The maximum adult dose of this drug which is at all well tolerated is 5 grains, but, when given in one dose, 5 grains will usually leave as many ascarids as it removes or more than it removes. Santonin develops its efficacy against ascarids to the greatest extent when the drug is given in repeated small doses over a period of a number of days. As a basic procedure one may give 1 to 2 grains daily for one week to 10 days for adults, and a dose of a quarter grain daily for the same period for children. These doses may be varied in accordance with the age, size, and general condition of the patient. It is impossible to state definitely the precise dosage of any drug for all persons, for the precise dose depends upon the individual judgment of the physician. In dealing with children the apparent age, rather than the chronological age, should be made the basis for determining the size of the dose.

*Purgatives.*—In general calomel in amount equal to the amount of santonin is a satisfactory purgative, and if no bowel movement occurs in four hours salts may be given at the end of that time. Purgation should be secured by whatever measures are necessary after eight hours.

*Other measures.*—As for chenopodium.

*Action of drug.*—Santonin affects the brain and causes yellow, green, or, rarely, blue vision, and produces the customary headache, dizziness, and nausea commonly produced by anthelmintics in general.

*Contraindications.*—Nervous disorders, such as epilepsy.

#### HOOKWORMS

The drugs which are used for the treatment of hookworm disease include carbon tetrachloride, tetrachlorethylene, chenopodium, thymol, and betanaphthol. Carbon tetrachloride and chenopodium are the most extensively used drugs, tetrachlorethylene is a very promising drug which is now receiving extensive test, and thymol and betanaphthol which have been extensively used in the past, appear to be losing ground to the other treatments. The two drugs named last are not discussed here.

#### CARBON TETRACHLORIDE

Carbon tetrachloride was proposed as a drug for the treatment of hookworm disease in 1921 and has come into wide use for the reason that it is very effective, very cheap, very stable, and not unpleasant to take.

*Dose.*—The adult dose is 3 c. c. The doses for children are approximately as follows, the age given being the apparent age and not necessarily the chronological age: 3 to 5 years, 0.5 c. c.; 6 to 10 years, 0.75 c. c.; 11 to 14 years, 1 c. c.; 15 to 19 years, 2 c. c.

*Purgative.*—Salts, sodium sulphate, as already given in connection with other drugs, to be administered at the same time as the carbon tetrachloride. In private practice the anthelmintic may be administered in capsule, but in mass treatments the carbon tetrachloride is poured into a glass containing 90 c. c. of the diluted solution of salts, and the patient drinks this.

*Other measures.*—Preceding and during the time of treatment the patient should avoid alcohol, fats, cream, oils, and meat. A high carbohydrate diet is indicated. An adequate supply of ionized blood calcium is essential in connection with this drug, and, as a means of obtaining this, the patient should be given, whenever possible, a pint to a quart of milk daily for a week or two preceding treatment, or supplied with calcium lactate or some other calcium preparation for this period.

*Action of drug.*—Carbon tetrachloride in therapeutic doses is practically all absorbed and is excreted in the expired air. In its passage through the liver it causes an acute yellow necrosis and this condition goes on to practically complete repair in the course of two weeks. Under certain conditions there is an associated bilirubinemia, and, in severe cases, the combination of bile salts with the ionized blood calcium may lead to a calcium tetany which is sometimes fatal. It has been recently ascertained that there is an increase of guanidine in the blood, and in this connection it has been recommended by Lamson and his collaborators that the patient avoid meat. The older work of Whipple, and the more recent work of others, indicate the advisability of a high carbohydrate diet.

*Contraindications.*—The contraindications for the use of carbon tetrachloride include acute or chronic alcoholism, gross ascariasis, and a low ionized blood calcium content. These are the three conditions which are of special importance in connection with the use of this drug. Other contraindications are the presence of undigested food in the stomach and febrile conditions. In cases of gross ascariasis, complicated with hookworm disease, the patient should be treated with oil of chenopodium, or, better still, with a mixture of oil of chenopodium, 1 part, and either carbon tetrachloride or tetrachloroethylene, 2 to 3 parts, as noted later. It has been found that weak and anemic children, with ascarids and hookworms present, respond badly to carbon tetrachloride treatment, as carbon tetrachloride appears to cause a clumping of the ascarids, and the atonic intestine of a feeble child is unable to remove these worm masses, the result being intestinal obstruction. Theoretically, there may be present also a toxic condition due to the dissolving of more or less poisonous substances from the ascarids by the carbon tetrachloride and the subsequent absorption by the patient of these products dissolved in the drug.

## TETRACHLORETHYLENE

This drug was proposed for the treatment of hookworm disease in 1925, has since been reported on in a dozen or so papers, and is now being tested in a large series of cases by Lambert in the Fiji Islands and other islands of the Pacific. The principal advantage in the use of this drug is its apparent safety. In veterinary medicine it has been found to be very well tolerated by kittens, pups, and foxes, these animals being relatively susceptible to the bad effects of carbon tetrachloride. As the deaths from carbon tetrachloride administered in mass treatments, where little attention can be paid to contraindications, is only about 1 in 32,000, according to Col. F. F. Russell, it would require at least 100,000 cases, probably, to ascertain the safety of tetrachlorethylene as compared with carbon tetrachloride. The drug has the disadvantage that some samples, though not all, tend to decompose under certain conditions, with the formation of chlorine compounds which include phosgene. This does not appear to be such a serious matter, as phosgene (carbonyl chloride) would apparently break up in the stomach to form hydrochloric acid and carbon dioxide, both of which would be innocuous in the stomach, although hydrochloric acid, when formed in the lungs after the inhalation of phosgene, is a very serious matter as the use of this gas in the World War demonstrated. Apparently a very pure sample of the drug will not break down; the breaking down is due to impurities of some sort.

*Dose.*—The dose for adults is 3 to 4 c. c., and for the time being the dose for children may be regarded as the same as that of carbon tetrachloride for children.

*Purgative.*—Sodium sulphate solution as for carbon tetrachloride, and given at the same time that the tetrachlorethylene is given.

*Other measures.*—The usual procedures as for carbon tetrachloride. Procedures in connection with tetrachlorethylene are not well established. The drug appears to be absorbed only to a very slight extent and no lesions have been found associated with it as yet.

*Action of the drug.*—This is not yet well known. It produces in the patient, as a rule, only those symptoms of headache, dizziness, and nausea which are customarily associated with all of the anthelmintics, and to some extent with the purgatives used in connection with them. Kendrick (1929) has reported that a 28-year-old syphilitic, weighing 100 pounds, was unconscious for a time following the administration of the 3 c. c. dose.

*Contraindications.*—At the present time the contraindications are unknown but one should follow the general rule of not administering this drug in the presence of febrile diseases.

## CHENOPDIUM

In the treatment of hookworm disease or ascariasis with chenopodium, one should use an oil which has a standardized content of the effective anthelmintic constituent, ascaridol, as the ascaridol content of samples not standardized varies considerably, leaving the matters of efficacy and safety somewhat uncertain.

*Dose.*—The adult dose which is commonly used is 2 c. c. divided into three doses of 10 minims each, these being given at 1-hour intervals. This may be regarded as a standard treatment, although various writers report from 1½ to 3 c. c. doses. Children should be given 1 minim (2 drops) for each year of apparent, not chronological, age up to 12 years. Beyond that the dose schedule is as follows: 13 to 14 years, 13 minims; 15 to 16 years, 16 minims; 17 to 18 years, 20 minims; 19 to 20 years, 24 minims.

*Purgative.*—The question of a purgative with chenopodium, as already noted, is still a moot point, the preference in general being given to salts rather than castor oil. If castor oil is used, one-half ounce should be administered with each of the 10-minim doses. When salts are given, 90 c. c. of the diluted sodium sulphate solution should be given one hour after the last dose of chenopodium.

*Other measures.*—See chenopodium for ascarids.

*Action of drug.*—See chenopodium for ascarids.

*Contraindications.*—See chenopodium for ascarids.

## ASCARIDS AND HOOKWORMS

## MIXTURES OF CHENOPDIUM AND CARBON TETRACHLORIDE OF TETRACHLORETHYLENE

For mixed infestations with ascarids and hookworms a mixture of one part of chenopodium and 2 to 3 parts of carbon tetrachloride or tetrachlorethylene is very effective and satisfactory.

*Dose.*—As for carbon tetrachloride.

*Purgative.*—Diluted sodium sulphate solution given at the same time as the anthelmintic.

*Other measures.*—As for the drugs involved except that ascariasis is disregarded as a contraindication for carbon tetrachloride.

*Action of drug.*—That of the components.

*Contraindications.*—As for the components, disregarding ascariasis for carbon tetrachloride.

## WHIPWORMS

The removal of whipworms presents some difficulties which appear to be associated entirely with the site of the infestation. Whipworms appear to be highly susceptible to many anthelmintics, and even to such things as mercurochrome, a drug which has little or



no effect on the other worms against which it has been tested. Many of these drugs will remove whipworms, but they are not dependable, and this lack of dependability appears to be associated with a failure of the drug to come in contact with the worms. The worms occur in the cecum, usually near the tip, and apparently not everything that passes the ileocecal valve enters the cecum. An anthelmintic may pass on into the colon, or may enter only the lower portion of the cecum and never come in contact with the worms. Theoretically, one might overcome this difficulty by using drugs of relatively low toxicity, which could be administered in large doses with some likelihood that at least part of the dose would enter the cecum, or by using drugs which are not gastrointestinal irritants, and which could be given in small doses over relatively long periods of time, on the assumption that sooner or later some of the drug would enter the cecum and come in contact with the worms. In practice this is what is attempted; as a bulky drug of low toxicity, one may use *leche de higueron*, and as a drug which is not a gastrointestinal irritant and which can be given over long periods of time, one may use santonin.

#### LECHE DE HIGUERON

This is the latex of sap of one of the figs, preferably *Ficus laurifolia*. Other species of *Ficus* have been used, including *F. elastica*, but in view of our ignorance of the constituents and action of these latices it is advisable at present to use the one which has been most used and is best established. Up to rather recently it was only possible to obtain this drug in the tropics where it can be used fresh, but it is now marketed with a preservative which appears to keep it in good condition for long periods of time. This drug has the special advantage that it practically always removes some of the whipworms present, even though it rarely removes all of them in the course of one treatment. Apparently the treatment could be repeated every two weeks until fecal examination showed that the worms were removed.

*Dose.*—The adult dose is 30 c. c. administered once or given in the morning for each of three successive days.

*Purgative.*—Sodium sulphate in dilute solution one hour after treatment.

*Other measures.*—The usual routine procedures already prescribed should be followed as no special measures have yet been associated with the use of this drug.

*Contraindications.*—The general contraindications for the use of anthelmintics should be observed as no special contraindications have yet been established for this drug. The drug is toxic to some extent, and one fatality has been verbally reported to me. This fatality

should not be weighed too seriously against the drug for the reason that it is not always possible to make sure that the latex furnished in the Tropics is actually the latex of *F. laurifolia*, and it may be that the latices of other species have a toxicity which the latex of *F. laurifolia* does not have.

#### SANTONIN

Santonin may be used in repeated daily doses for the removal of whipworms, as already noted, on the assumption that sooner or later the drug will enter the cecum and remove the whipworms.

*Dose.*—As for ascarids, except that the treatment may fail to clear up an infestation in the course of a week or 10 days, in which case treatment may be discontinued for a week, and then repeated, this procedure being followed until the feces are negative for whipworm eggs.

*Purgative.*—Calomel in amount equal to the amount of santonin as for ascarids.

*Other measures.*—Administer the drug every morning before food is taken and allow food after the bowels move.

*Action of drug.*—See santonin for ascarids.

*Contraindications.*—See santonin for ascarids.

#### PINWORMS

The removal of pinworms presents numerous difficulties, and at the present time there is no well-established treatment supported by adequate evidence as to its value for pinworm infestations. The difficulties here are associated with the life history of the worm. The young pinworms are found in the small intestine, and after fertilization the gravid female passes to the large intestine. When it is ready to deposit eggs it migrates from the rectum through the anus to the perineum, and usually moves forward about an inch along the perineum, either depositing eggs as it moves or coming to rest and depositing all the eggs in a small clump. After the eggs are deposited almost all that is left of the female worm is the shriveled cuticle resembling a bit of scurf skin. For some unascertained reason these eggs cause an anal puritis which gives rise to scratching, and in this way the fingers become contaminated with the eggs, and these are conveyed back to the mouth directly or on food or other articles which come in contact with the mouth.

The efficacy of anthelmintics for the removal of pinworms can not be judged by fecal examinations since the eggs are not deposited in the bowel but on the perineum. The worms usually migrate from the rectum within an hour or two after the patient goes to bed, and in order to check the success of the treatment it would be necessary to carry out repeated examinations by means of anal swabs, a method

of testing which has not yet been undertaken. Until something of the sort has been done it would be difficult to select a drug for the removal of pinworms with any certainty as to what the drug will accomplish.

#### TETRACHLORETHYLENE

Tetrachlorethylene is suggested as a drug for the removal of pinworms on the theoretical ground that it appears to be a relatively insoluble drug which does pass to the large intestine in amounts sufficient to destroy pinworms. The clinical evidence in its favor is the fact that pinworms were removed from patients in Nicaragua, as reported by Hall and Augustine, in a fairly large percentage of cases, and that in one case a dose of 4 c. c. removed 5,544 pinworms from one soldier. This of itself would only warrant further tests and does not establish the value of the drug.

*Dose.*—See tetrachlorethylene for hookworms.

*Purgative.*—See tetrachlorethylene for hookworms.

*Other measures.*—There are numerous adjunct measures which are essential in the treatment of pinworm infestation. It is not sufficient that the young worms be removed from the small intestine by the anthelmintic, or even that the gravid females also be removed from the large intestine. The anal region is an infested area and special attention must be directed toward the maintenance of cleanliness in this region, particular care being taken to cleanse this region thoroughly by washing after defecation. The use of anal ointments at night with the idea of destroying any female pinworms which might be present, has been recommended and while this procedure has been criticised it would probably be just as well to observe it for the time being until we know more about this subject. Since we have no assurance as to the dependability of any anthelmintic for the removal of pinworms, the patient should be given a copious high enema just before retiring in order to remove any gravid females which may be ready to migrate to the perineum that night. In addition to the infection on the perineal region one must keep in mind that the underwear, night clothing, and bed clothing will also be infected, and that these things should be handled with care and laundered in boiling water to insure the destruction of the pinworm eggs. The Germans have reported good results from the daily use of a mild laxative, such as senna, to keep the stools in a soft condition, and it is possible that this procedure may be disadvantageous to the worms. Consequently it is worth using as an adjunct measure. Various diets, including an antidiabetic diet, have been reported as of value in the control of pinworm infestation, but this subject is inadequately investigated as yet. In cases of pinworm infestation in children it is advisable to use mittens, if necessary, to prevent

scratching, and also a type of nightwear which will not allow the hands to come in contact with the skin.

*Contraindications.*—See tetrachlorethylene for hookworms.

#### MISCELLANEOUS DRUGS

German writers, including Brüning, who is a very able physician and well informed in the theoretical and practical aspects of anthelmintic medication, report very favorably on aluminum subacetate for the treatment of pinworm infestation. The doses recommended are 1 gram t. i. d. for adults and 0.5 gram b. i. d. for children. Some English writers recommend bismuth subcarbonate. The dose for adults is 5 grams b. i. d.; for children 7 years old, 4 grams daily; for younger children, 2 to 3 grams daily. The treatment is repeated for five successive days, then discontinued for five days; and this procedure is carried out for three series of treatments.

#### STRONGYLOIDES

At the present time it does not appear that we have a satisfactory treatment for Strongyloides. Various things have been reported as satisfactory, but as a rule the subsequent work of other investigators has not confirmed the early report. The report which seems to have the most promising results for a series of cases is that of Willis (1922) who treated 60 cases with oil of chenopodium, giving 1.5 c. c. to adults and repeating this in 1 week, 2 weeks, and 6 weeks. He states that no eggs or larvae were found after the second week.

#### TRICHINOSIS

It is commonly recommended that this or that anthelmintic be used to remove adult trichinae from the intestine in first-stage trichinosis. Actually the value of this treatment has never been established for any drug, and it is not known which drugs will affect these worms. In some tests on experiment animals, Dr. W. H. Wright, of the zoological division, was unable to remove trichinae with any of several promising anthelmintics, including tetrachlorethylene, carbon tetrachloride, and chenopodium.

#### TAPEWORMS

In general the removal of tapeworms presents more uncertainties than the removal of round worms parasitic in the small intestine. The large tapeworms are usually present in very small numbers, usually one, when present at all, and the success or failure of the treatment depends upon removing the head of this tapeworm. There is no partial success, as with treatments for nematodes present in

large numbers, of which many may be removed and a few left. It is true that the small rat tapeworm, *Hymenolepis nana*, may be present in large numbers, and that treatments might be partial successes with this worm. However, we have no system similar to our worm and egg count method whereby one can determine readily the approximate effect of a treatment for removing these tapeworms.

Contrary to the general rule in treatments for removing nematodes, it is advisable to use preliminary purgation with salts the night before treatment for the removal of tapeworms, the idea being to flush out the digestive tract and remove the mucus from around the head of the tapeworm, thereby exposing the head to the action of the anthelmintic. While this line of argument is pure theory and not substantiated by any direct evidence, better results appear to follow from treatments administered after preliminary purgation and for this reason a purgative should be given.

#### TANRET'S PELLETTIERIN

It is contrary to my policy to recommend proprietary remedies, but the preparation made by Tanret has given uniformly satisfactory results in the cases in which it has been used and with which I am familiar in clinical practice and experimental test, for the removal of tapeworms. It is put up as a syrup and is less unpleasant to take than most of the tapeworm remedies. The dose, purgative and other measures are covered in the manufacturer's directions and should be followed as given. The known contraindication for this drug is epilepsy. In general, it appears to be quite safe. It has one objectionable feature in that it is quite expensive.

#### CARBON TETRACHLORIDE

In tests on experimental animals carbon tetrachloride has never been found to be of any value in the removal of tapeworms. It is, therefore, surprising to find as a result of clinical experience in the tropics, that carbon tetrachloride is quite effective in removing the large human tapeworms, *Taenia saginata* and *Taenia solium*. The treatment is the same as for hookworms except that the patient should be on liquid diet the entire day before treatment, and should be given a preliminary purgative, sodium sulphate, the night before treatment. This drug is very commonly used for the removal of tapeworms from man in the Philippines, Central America, and elsewhere. In Panama, after the use of carbon tetrachloride in the hookworm campaign, the incidence of *Cysticercus cellulosae* in swine at Panama City fell from 15 to 5 per cent, as a result, presumably, of the removal of *Taenia solium* from part of the rural population engaged in raising swine.

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## OLEORESIN OF MALE FERN

This drug may be regarded as the classical drug for the removal of tapeworms, and male fern in some form has been used for this purpose for thousands of years, apparently.

*Dose.*—The adult dose is  $1\frac{1}{2}$  to  $2\frac{1}{2}$  drams, with 2 drams as the dose which would usually be employed. The dose for children is one-half to 1 dram. Some authorities recommend that one-quarter of the total dose be given every 15 minutes and a purgative given an hour after the last dose. The drug is best administered in capsule, as it is very bitter and it is useless to add unnecessarily to the discomfort of a patient. See *Other Measures*.

*Purgative.*—Where purgation is delayed until one hour after the administration of this drug as one dose, or until an hour after the last of four split doses, it is advisable to use sodium sulphate solution as already recommended in previous treatments. Textbooks quite commonly state that castor oil must never be given with male fern, as it will increase its solubility. There appears to be no valid evidence in support of this contention and there is evidence to show that adequate doses of castor oil are satisfactory and safe in connection with oleoresin of male fern. If the drug is all given in one dose, it may be accompanied by an ounce of castor oil, and if the drug is given in four split doses, each of these doses may be accompanied by 10 c. c. of castor oil. Where the administration of the purgative is delayed an hour or more after treatment with any anthelmintic, it is advisable to use salts and not castor oil. In the cases of such drugs as may be advantageously used with castor oil, the castor oil should be given immediately before the anthelmintic, or else accompanying it.

*Other measures.*—As for other anthelmintics in general. It has been recommended that oleoresin of male fern be given by means of the duodenal tube, the drug being mixed with castor oil or with mucilage of acacia, and the entire dose given at one time. This procedure is said to result in a higher percentage of cures than the administration of the drug by mouth.

*Contraindications.*—Gastroenteritis, nephritis, febrile conditions, and pregnancy.

## FILARIDS

In discussing the treatment of filariasis, it is necessary to treat of different species of filarids separately as they do not all respond alike.

*Wuchereria bancrofti.*—No treatment appears to be well established for *W. bancrofti* (*filaria bancrofti*) in the sense that it has been shown that any drug can be depended on to kill the adult worms and the larvæ in the circulating blood, with the subsequent clearing

up of lesions and symptoms. Since the larvæ in the blood may disappear spontaneously, it is unsafe to conclude too much from their disappearance after treatment, and experience indicates that if one continues observations after treatment the larvæ reappear. The little that is known on this subject up to the present time indicates that salvarsan may give good clinical results in clearing up the chyluria or improving the condition of elephantiasis. Phenokoll has been reported as of value in connection with filarial fever and late elephantiasis. Tartar emetic has been reported as beneficial in connection with lymphangitis, elephantiasis, and fever. Aside from anthelmintics, Rose (1919) has reported benefits from the use of streptococcus bacterins.

*Filaria perstans*.—No treatment yet found beneficial.

*Loa loa*.—No treatment has been established as of value for the destruction of this parasite, the literature indicating that apparently promising results are not confirmed by later work, and that too few investigations have yet been made to establish anything as of value.

*Dracunculus medinensis*.—Richards (1922) makes the astonishing report that where a pound of sugar was fed daily the worms came out on the third day instead of requiring weeks for their removal. Novarsenobenzol, in four doses of 0.15, 0.3, 0.3, 0.45 gram at 8-day intervals, is reported as a satisfactory treatment, this treatment being followed by abscess formation and the extraction of the dead worm.

#### SCHISTOSOMES

#### TARTAR EMETIC

Whenever patients will tolerate tartar emetic, and there is nothing which makes intravenous injections impossible or extremely difficult, the employment of this drug is very satisfactory for the treatment of schistosomiasis.

*Dose*.—Use a stock solution of 1 grain in 20 minims of distilled water, and give intravenously every other day, the dose beginning with one-half grain, then 1 grain, 1½ grains, 2 grains, 2½ grains, and then 2½ grains up to a total dosage of 30 grains, if necessary. Cure is usually effected with a total dosage of 20 to 30 grains, and in most cases with 25 grains or less. Do not carry one course of treatment beyond 30 grains, and, if necessary to repeat treatment, wait several weeks or months before doing so.

*Purgative*.—None.

*Other measures*.—Extreme caution and good technique.

*Action of drug*.—The drug is a local irritant, depresses the circulation, respiration and nervous system, and it has been reported as killing a child in a dose of one-half grain.

*Contraindications.*—Diseases of the heart, lungs, kidneys, or liver, such as cirrhosis and ascites, or a low metabolic condition. Lasbrey and Coleman (1921) reported 1 per cent of deaths in 1,000 cases.

#### EMETIN

Emetin is substantially as satisfactory as tartar emetic in the treatment of schistosomiasis, and has the advantage that it may be given hypodermically or intramuscularly. The doses which have been recommended vary, but the following may be taken as sufficiently representative: 0.03 gram hypodermically, b. i. d. for 10 days; or one-half grain up to 2 grains for an adult, and one-third to 1 grain for a child of 12 years, intramuscularly, for 3 days, and then three times a week for 3 weeks.

*Action of drug.*—The drug may cause diarrhea, neuritis, circulatory failure, and toxic conditions.

#### FASCIOLOPSIS

This parasite is a very serious pathogen, causing severe symptoms and, in many cases, death.

#### CARBON TETRACHLORIDE

Carbon tetrachloride administered in the same dose and manner as for hookworms is very effective in removing these flukes.

#### BETANAPHTHOL

This is the drug which Barlow prefers for the removal of Fasciolopsis.

*Dose.*—Four grams.

*Purgative.*—Sodium sulphate solution as for other anthelmintics one hour after treatment.

*Other measures.*—As for anthelmintics in general.

*Action of drug.*—Betanaphthol may cause the destruction of red blood cells, giving rise to anemia, icterus, and hemoglobinuria, and enlargement of the spleen and liver.

*Contraindications.*—Malaria, anemic conditions, and pregnancy.

#### CLONORCHIS

While some good results and apparent cures have been reported with arsphenamine and tartar emetic, the reports in general show failures, inconsistent results, or lack of adequate evidence in support of the treatment, and apparently we have no established satisfactory treatment at the present time.



**PARAGONIMUS**

From the reports on the medicinal treatment of cases of infestation with lung flukes one can only conclude that the evidence in favor of any drug as curative is unconvincing and that at the present time we have no established treatments.

**SOMATIC TAENIASIS**

An inspection of the reports of medicinal treatment of hydatid, cysticercosis, and similar conditions indicates that we have no medicinal treatment established as of value for the destruction of larval tapeworms.

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**SODIUM THIOSULPHATE IN THE TREATMENT OF SYPHILIS**

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During the treatment of two recent cases of neoarsphenamine dermatitis it was noticed that the injection of sodium thiosulphate intravenously caused the patients to complain of tasting arsenic and to experience the usual sequelæ to its administration—nausea, vomiting, chills, and malaise. In both cases sodium thiosulphate at first increased the severity of the dermatitis but later caused its gradual but total disappearance. The Kahn reactions in both cases were lowered without any further treatment and in one, a patient who presented himself with a virulent infection with a 4 plus reaction, the blood was rendered Kahn negative after 9 injections of neoarsphenamine and the 6 doses of sodium thiosulphate used in treating the dermatitis that developed, and had remained Kahn negative for 13 months without further treatment. It has also been noticed that people who experience severe reactions when neo-salvarsan is administered seem to become Kahn negative more rapidly and more surely than do those who are not greatly affected by arsenic administration, but these do not necessarily remain so without further treatment.

Such occurrences naturally led to speculation and later to a study of the possible rôle that sodium thiosulphate might play in anti-luetic therapy. Does it render arsenic more toxic to the spirochetes or the spirochetes more susceptible to arsenic? Does it form a new compound with the arsenic which is a more efficient spirocheticide? Does it liberate stored up arsenic and make it available for use as a spirocheticide or has it a direct toxic effect on the organism itself? Or has it any effect at all? These were some of the questions that immediately presented themselves and stimulated us to the following study. Presuming that sodium thiosulphate has some effect on the

course of a luetic infection and keeping in mind its uses as an antidote for poisoning by the heavy metals this then suggested a method of treatment of syphilis in which we might derive the maximum benefit from the minimum amount of neoarsphenamine, insure against the possibility of arsenic poisoning during intensive treatment, which, of necessity is required in certain cases, and enable us, by using it in combination with arsenicals, to treat cases with idiosyncrasy for arsenic.

With these thoughts in mind it was decidedly interesting to read the report of Kimbrough (1) in the April, 1928, issue of the Naval Medical Bulletin in which he gives an account of his observations on the use of sodium thiosulphate as an adjunct to neoarsphenamine and reports a series of cases in which he was able to produce negative serological reactions in persistent Kahn-fast patients by its use in small doses after a course of an arsenic compound given in conjunction with mercury and iodides.

We have under observation and treatment at all times a certain number of patients who are classed as Kahn-fast in which no reasonable amount of salvarsan or neosalvarsan, given over a period of years, in conjunction with mercury and iodides, is sufficient to render the blood negative. Also there are a certain number who are so sensitive to arsenicals that they get (1) immediate, or (2) delayed, severe reactions from its administration. The immediate reaction is usually characterized by a giant urticaria appearing from 10 minutes to 3 hours after the administration of the arsenical compound and is accompanied by nausea, vomiting, intense itching and burning of the skin and marked congestion of the mucous membranes, most noticeably the conjunctivae. The second type is illustrated by the Herxheimer reaction which will be mentioned later. Another form of the second type is the exfoliative dermatitis or its counterpart in the internal organs, which comes later and is due to the storing up of arsenic in the tissues of a susceptible individual, and usually appears after a few doses of the drug have been given. These manifestations of a drug intolerance are often alarming and are always inimical to the peace of mind of all who are called upon to administer antiluetic treatment. The first of these two accidents can usually be controlled by giving adrenalin intramuscularly as soon as the symptoms appear, and can be prevented in those known to be sensitive in this manner, by the use of adrenalin immediately after the salvarsan is given. The second and most common type of reaction comes on 6 to 10 hours after injection and is characterized by a rise in temperature, 100° to 102° F., exaggeration of the inflammatory process in all existing lesions, and a feeling of malaise.

The severity of the reaction depends on one of two, or both, factors: (1) Abundance of spirochetes, and (2) dosage of the drug.

An avoidance of this type of reaction consists in giving a small initial dose of arsenic or, as Stokes (2) recommends for certain cases, the preparation of the patient with mercury before the institution of arsenicals. Ordinarily this is not necessary in early syphilis unless the process involves important structures, when any great exaggeration of the inflammatory process would result in disaster. Routinely a small initial dose of arsenic will suffice to keep the reaction mild. The third type of reaction comprises the arsenic poisoning group and may be classed for convenience as those exhibiting the "accumulation syndrome." These manifestations of a drug concentration do not comprise, as the term would imply, a single set of symptoms but many and varied symptoms depending on the class of tissue involved and extent of involvement. However, they have the one factor in common, that of being due to a toxic accumulation of arsenic by repeated administration of this drug in a subject with low tolerance for it. It is with this large group, which has the greatest mortality from antiluetic reactions, that we are most concerned in this paper.

The object of this study was to determine what effect, if any, sodium thiosulphate might have on the course of a leutic infection, either in rendering Kahn-fast cases serologically negative or in preventing untoward accidents in others. The experiments were started along certain well-defined lines but after a short time necessary departures in the technique were made. We picked for the start of the experiment 16 patients, some of whom were classed as Kahn fast, two who fell into the group of anaphylaxis reactions, and others who were more or less resistant to treatment although they could not be classed definitely as Kahn fast. At first they were all given their regular injection of neoarsphenamine on Tuesday of each week, and on Friday received 1 gram of sodium thiosulphate intravenously, but later the amount of sodium thiosulphate was increased to 1 gram three times weekly and the neoarsphenamine was discontinued. Of course, these people had all a great deal of arsenic during the course of their infections before joining the group, and it was partly due to this fact that neoarsphenamine was discontinued, as it was thought they had all previously had a sufficient amount.

Frequent blood Kahns were done and the patients watched for the occurrence of any unpleasant reactions. Short abstracts of the history of each patient have been tabulated for a more graphic representation of the improvement and for a chronological correlation of their treatment and serological reactions.

First we shall consider the group classed as Kahn (or Wassermann) fast, eight cases in all. These patients had been under treat-

ment for from 1 to 12 years previously, with various arsenical compounds plus mercury and iodides, and some had received remarkably large quantities of arsenic with little or no effect on the serological reaction.

**CASE I—W. B.**—Has had fifty-six 0.9-gram doses of nearsphenamine with a great deal of mercury, but his blood remains positive until neosalvarsan was discontinued and he was given sodium thiosulphate. Blood Kahn six weeks after sodium thiosulphate was started became negative for the first time. After remaining Kahn negative for three weeks his blood returned 4 plus, whereupon he was started on a course of neosalvarsan and sodium thiosulphate and became Kahn negative in four weeks from the commencement of this treatment. Later his blood returned Kahn 2 plus.

**CASE II—A. B.**—Became infected in 1917 and since then had received irregular treatment until 1927, when he was given intensive treatment with nearsphenamine and mercury, but no reduction in his blood reaction was apparent until the nearsphenamine was stopped and he was given sodium thiosulphate. Blood Kahn one month after sodium thiosulphate was started became negative, and remained so for two months, at the end of which time he became Kahn I plus. Further treatment with neosalvarsan brought his blood to negative.

**CASE III—J. H. S.**—Infected in 1924; received a large amount of neosalvarsan, 53 injections from 1924 to August, 1928, with no reduction in his blood Kahn. Then he received 3 more neosalvarsan injections with sodium thiosulphate at weekly intervals. Blood Kahn six weeks after sodium thiosulphate was started became negative and has remained so for six months.

**CASE IV—F. M. R.**—Infected in 1916; received a large amount of neosalvarsan with mercury, but his blood remained from 2 plus to 4 plus. Neosalvarsan was discontinued and he was put on sodium thiosulphate. Blood Kahn six weeks after sodium thiosulphate was started became negative for the first time. It remained so for three weeks and then returned 4 plus, but after further treatment with neosalvarsan became negative. This man passed from observation shortly after this and further data are not at hand.

**CASE V—S. K.**—Date of infection is unknown, but he was first found with a positive blood in 1926; since then he has had a fairly large amount of neosalvarsan and mercury, with no change in his blood reaction. He was started on sodium thiosulphate at weekly intervals and later three times weekly. Blood Kahn eight weeks after sodium thiosulphate was started became negative without further recourse to arsenicals, but returned to a 4 plus shortly after and did not respond to further arsenical administration. When he passed from observation his blood was still 3 plus.

**CASE VI—R. L. F.**—Infected in 1924; received a large amount of neosalvarsan and mercury, which made no change in his blood reaction. Started injections of sodium thiosulphate after 48 injections of salvarsan, but he developed a specific sore at the site of the original lesion. Dark field positive. Salvarsan in conjunction with sodium thiosulphate continued for two courses, at the end of which time his blood was still positive 3 plus and he passed from observation.

**CASE VII—D. J. E.**—Infected in March, 1927. Received forty-two 0.9-gram doses of neosalvarsan, with no improvement. Blood Kahn after neosalvarsan was stopped, and seven weeks after sodium thiosulphate was started became negative. Three weeks later his blood returned 2 plus again, but he responded to neosalvarsan and at present is Kahn negative.

**CASE VIII—E. E.**—Infected in August, 1927. Received 40 injections of neosalvarsan, at the end of which time his blood was 4 plus. After neosalvarsan was discontinued and he had received sodium thiosulphate for five weeks blood Kahn became negative and has remained so for six months.

The next group to be considered are those border-line cases which are not as yet Kahn-fast and have not responded to treatment as they should—some of them, it is true, having received only occasional treatment.

**CASE IX—V. L. C.**—Infected in June, 1925. Had a positive dark field and received six injections of neosalvarsan and remained Kahn negative until April, 1927, when his blood returned 3 plus. He then received eight more neosalvarsans and remained negative until August, 1928, when his blood returned Kahn 4 plus. He was then given neosalvarsan in weekly injections in combination with sodium thiosulphate, the latter being increased later to 3 grams weekly. This is a case in which the patient received insufficient early treatment to handle his infection. Under the new régime arsenic and sodium thiosulphate were pushed and he became Kahn negative in six weeks, but later his blood became positive again and neosalvarsan therapy was commenced. He responded favorably and left our service with a negative reaction.

**CASE X—S. H. B.**—Infected in 1927; received 24 injections of neosalvarsan with no effect on his 4 plus blood reaction. Blood became negative when treated with the combined arsenic and sodium thiosulphate injections in 12 days and remained negative until he passed from our observation six months later.

**CASE XI—A. C. J.**—Infected 1927; received 30 injections of neosalvarsan with one temporary drop in his blood reaction and a return to 4 plus, but he became Kahn negative six weeks after sodium thiosulphate administration was started and the neosalvarsan was discontinued. Three weeks later his blood was 4 plus again, but slowly returned to negative when given neosalvarsan, and when he passed from our observation, March, 1929, was still negative.

**CASE XII—G. A.**—Infection date unknown; was first seen with a perforating ulcer in the roof of his mouth and scars on his body from former luetic lesions which had been diagnosed as yaws. Received 23 neosalvarsans with little effect on his blood reaction, and he developed a protracted jaundice while under luetic treatment but during a mild epidemic of simple catarrhal jaundice to which he was exposed. Salvarsan was discontinued and he became Kahn negative with sodium thiosulphate within six weeks after its institution. A return to 4 plus necessitated reinstitution of neosalvarsan in conjunction with sodium thiosulphate, and when he passed from our observation, in March, 1929, his blood was Kahn negative.

**CASE XIII—W. D.**—Infected in June, 1928. Received 20 injections of neosalvarsan, at the end of which time his blood was Kahn 3 plus. Arsenic was discontinued, and after five weeks of sodium thiosulphate given in 1-gram weekly doses his blood became Kahn negative.

The next smallest group consisted of two patients in whom idiosyncrasy for arsenic resulted, in both cases, in immediate anaphylactic reactions and later in the formation of an exfoliative dermatitis.

**Case XIV—P. O. McC.**—Received eight small doses of nearsphenamine, each of which produced anaphylactic reactions which we were able to control with adrenalin. He developed an exfoliative dermatitis, for which he received eight

1-gram doses of sodium thiosulphate. He was then started on neosalvarsan again in conjunction with sodium thiosulphate and became Kahn negative in five weeks. A month later his blood returned Kahn 3 plus, spinal fluid Kahn 3 plus and globulin positive, with cell count of 63, at which time he was hospitalized. But strangely, during the time he was getting sodium thiosulphate his clinical improvement was so marked that the spinal-fluid findings came as something of a shock.

**CASE XV—J. P. S.**—Infected in June, 1928; experienced severe anaphylactic reactions after the second and third doses of neosalvarsan and developed a slight dermatitis; salvarsan resumed in conjunction with adrenalin and sodium thiosulphate given three times weekly. He tolerated this treatment well and became Kahn negative in less than five weeks. Our method here was to give him 0.45 gram of neosalvarsan on Tuesday, followed immediately by 1 c. c. of adrenalin intramuscularly, which prevented the severe reactions he had experienced after the second and third doses in which his temperature rose to 105° F. and he became alarmingly ill. Monday, Wednesday, and Friday of each week he was given 1 gram of sodium thiosulphate intravenously. This method allowed us to give arsenic to a patient who could not otherwise tolerate it.

**CASE XVI—F. B.**—Infected in March, 1927. Was given 24 injections of neosalvarsan, which resulted in dermatitis with extensive pigmentation. This pigmentation persisted for months after he became Kahn negative and treatment was discontinued, but it rapidly disappeared when he was given sodium thiosulphate in 1-gram doses three times a week. In this case sodium thiosulphate was given solely for the purpose of clearing up the unsightly lesions and with no thought of influencing the blood reaction, which was already Kahn negative.

The patients in Groups I and II all received, during the course of their infection, sufficient of the arsenic compounds and mercury to render the average case serologically negative, but no one of them responded as could be expected and they are therefore considered in the first group Kahn fast and in the second group as border-line Kahn-fast cases. In each case sodium thiosulphate was started in 1-gram weekly doses and increased to 1-gram thrice-weekly doses and neosalvarsan was discontinued. In nearly all cases the blood became Kahn negative, the average length of time required to render it negative being six weeks from commencement of sodium thiosulphate therapy, although two or three responded in one month or less. It is fair to assume in the face of these successful reductions in Kahn reactions that the drug being used at the time was, in part at least, responsible for the phenomenon observed. But from here on our conclusions assume the garb of speculation, as we are unable to say definitely in what way the sulphur compound affects the course of the disease. The most likely explanations, some of which have been advanced before by others, are: (1) Sodium thiosulphate, being a powerful oxidizing agent, oxidizes and renders available as a toxic agent the arsenic stored in the body cells as albumoids, and therefore prolongs the effects of a given quantity of neoarsphenamine. It has been said that 75 per cent of the arsenic injected in the form of

salvarsan has been regained from excretions and that at least 25 per cent has been unaccounted for. That unaccounted for 25 per cent may be stored in the body tissues and long bones and be released very slowly, until a powerful oxidizing agent hastens the breaking-down process and renders the arsenic available as a spirocheticide. (2) The abnormal tolerance which the spirochetes develop after prolonged treatment with arsenic is destroyed. The spirochetes may acquire a certain tolerance for arsenic in much the same way as the plasmodia of malaria acquire a tolerance for quinine by becoming saturated with it, and only lose this acquired tolerance when the accumulated drug is freed by the action of an oxidizing agent. (3) Salvarsan, by virtue of its  $\text{NH}_2$  groups, is a base capable of uniting with acids, and by virtue of its (OH) radicals it is also an acid capable of forming salts with alkalies, as does phenol. Our third hypothesis may be elaborated on one of a number of possibilities founded on chemical reactions: (a) That there is formed an alkaline sulpharsenate by the combination of the sulphur and arsenic compounds, either in the body tissues or in the spirochetes themselves, which is more lethal to the spirochetes than is the uncombined arsenic; (b) that the sodium thiosulphate acts directly as a spirocheticide was considered and experiments were tried which proved that the drug alone will not exert any influence on a positive blood, although it appeared to hasten healing of a primary lesion; (c) that the spirochetes may be destroyed during the process of oxidizing their accumulated arsenic.

Of the three hypotheses the first alone does not seem tenable because, if killing the organisms depended on that 25 per cent of unaccounted for arsenic it would only be necessary to give 25 per cent more of salvarsan during treatment to make up that amount. If it were a question of the tolerance of the organism for arsenic, which tolerance is destroyed by sodium thiosulphate, there is no logical reason why blood should become negative from a persistent Kahn 2, 3, or 4 plus after sodium thiosulphate therapy is instituted without recourse to arsenic.

A combination of the first two hypotheses—that sodium thiosulphate releases the arsenic accumulated in the organisms and destroys their tolerance for salvarsan, rendering them susceptible to the lethal action of the arsenic released from the body tissues of the host during the same oxidation process or to the action of arsenic supplied by further treatment, is an entirely reasonable conjecture and is fairly well supported by our observations.

That sodium thiosulphate has a definite spirocheticide action is hinted at in the rapid healing of the few dark field positive chancres on which we have tried it by local application and without the aid of any intravenous arsenic, but its action is not equally spirocheticidal

in the blood stream, as we have been able to show in a small group of cases that were treated with sodium thiosulphate alone for a short period of time.

As mentioned before, it was noticed that during the treatment of arsenic dermatitis the sodium thiosulphate temporarily, but markedly, increased the severity of the existing skin reaction, causing a quiescent rash to become red, to weep and desquamate. It was noticed also that the severity of this reaction could be controlled by the regulation of the dose of sodium thiosulphate; thus if 0.25 gram of sodium thiosulphate was given the exacerbation was less severe than when 0.5 gram or 1 gram was given. Accompanying this exacerbation of the dermatitis was a systemic reaction with increase in the patient's discomfort—rise in temperature, eructations, nausea, and the return of the unpleasant taste of arsenic. These observations forcibly demonstrated that the rate of arsenic excretion was effected by intravenous sodium thiosulphate and that a too large dose of sodium thiosulphate in a severe arsenic poisoning, in which there is an extensive dermatitis, was positively dangerous.

The dermatitis case usually escapes death because of an efficient excretory apparatus, but this is not always the case, and some deaths from arsenic poisoning which have occurred during treatment with sodium thiosulphate can probably be explained by a too rapid oxidation of the accumulated arsenic and overloading of the excretory organs far beyond their functional capacity, especially when they are already damaged. Recently Haag and Bond (3) (1927), in writing on the use of sodium thiosulphate treatment of poisoning by oral administration of arsenic, state they have proved conclusively that sodium thiosulphate is valueless in treatment of poisoning from oral administration of potassium arsenite. Here the supposed antidote was given following the minimum lethal dose of arsenic preparation. Our experience would indicate that sodium thiosulphate, instead of acting as a direct antidote, acts by oxidation of the arsenic which has accumulated in the tissues. The arsenic which is excreted in arsenic poisoning is not the arsenic that harms; it is that remaining in combination with the proteins of the body tissues which produces the arsenic poisoning, and it is here that sodium thiosulphate given in well-regulated doses plays its important rôle in slowly removing the arsenic combined with body cells. One dose of sodium thiosulphate will not cure an arsenic poisoning; this requires careful administration over a period of time, and in such doses that it will not oxidize the arsenic more rapidly than the various excretory organs of the body can handle it. We feel very strongly that the rate of excretion of arsenic from the body tissues can be regulated exactly by the amount of sodium thiosulphate given, and that too



rapid excretion will tax the already damaged skin or kidneys beyond their functional capacity, and death may be the result. As mentioned above, for two weeks we watched one patient with a severe dermatitis which nearly resulted in death, and were forcibly struck by the close relation between the amount of sodium thiosulphate given and his local and general condition, and found that we could control the severity of an exacerbation of the dermatitis by the amount of sodium thiosulphate given.

It is interesting to note that the period during which the bloods of the Kahn-fast cases remained negative on sodium thiosulphate alone was about three weeks in all the cases in which a positive reaction recurred, but that some of the cases have remained Kahn negative without any further treatment. All cases in which a plus reaction recurred were put on neosalvarsan on Mondays and sodium thiosulphate on Fridays, and we noticed that this time the clinical improvement corresponded closely to the improvement in the blood reactions, some of the cases showing a striking gain in weight and general health.

Recently Althausen and Gunther (4), reporting their observations on acute arsenic poisoning, state that the institution of sodium thiosulphate in their case caused a marked increase in deposition of arsenic in the hair and its elimination in urine and feces with a coincident and almost immediate clinical improvement in the patient. Such also has been our experience when administering sodium thiosulphate after a course of neosalvarsan, which was accompanied by loss of weight, appetite, and spirits. After two or three intravenous injections of sodium thiosulphate the patients showed marked clinical improvement as evidenced by weight, a return to normal in the color of the skin and mucous membranes, and general feeling of well-being.

#### SUMMARY

Eight patients who had been Kahn positive over periods varying from 1 to 12 years and were considered as Kahn fast, were rendered temporarily Kahn negative by the intravenous injections of sodium thiosulphate after arsenic compounds had been discontinued. Five cases which we considered as border line Kahn fast (they had not reacted as could be expected with treatment ordinarily sufficient) responded in the same manner as the definite Kahn fast. The average length of time required to render these patients Kahn negative was six weeks from the discontinuance of neosalvarsan and the institution of sodium thiosulphate. After remaining Kahn negative for about three weeks on sodium thiosulphate six of the cases became serologically positive again, but returned to negative and showed marked improvement clinically when a "follow up"

course of neosalvarsan and sodium thiosulphate were given. One patient who did not respond in this manner was found to have a positive spinal fluid. Two patients with sufficient idiosyncrasy to arsenic to debar its use were successfully treated without recurrence of their severe reactions and rendered Kahn negative by this method. Great clinical improvement was noted in patients under treatment for syphilis upon institution of intravenous sodium thiosulphate, either in conjunction with salvarsan or as a separate medication after a course of salvarsan.

#### CONCLUSIONS

1. Sodium thiosulphate has a definite place in antiluetic therapy.
2. When given to patients under an antiluetic régime, sodium thiosulphate caused marked clinical improvement as evidenced by gain in weight, return to normal in the color of the skin and mucous membranes, and general feeling of improvement.
3. Most persistent Kahn positive bloods can be temporarily rendered Kahn negative in a short period of time (about 5 to 6 weeks) by the use of sodium thiosulphate. The majority of these will return to Kahn positive status if further treatment with an arsphenamine is not given.
4. Cases which return to a Kahn positive status after being rendered negative by sodium thiosulphate and salvarsan should be investigated further with special emphasis on the cerebrospinal fluid.
5. Sodium thiosulphate should be used with caution in treatment of arsenic poisoning to avoid permanent damage to certain tissues.

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#### THE RELATION OF PROCTOLOGY TO GENERAL MEDICINE

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Since the physician in general practice is more inclined to view the patient as a whole, many eminent men, specialists in some particular field of medicine, have said that no man should confine his practice to a specialty until he has completed several years in general medicine. However, even in general work there is a decided tendency to overlook one of the most important and fertile sources of disease in the entire body—namely, the large bowel, anus, and rectum.

Many physicians do not stop to consider the diseases of the rectum and anus as having any bearing on general diagnosis. Yet Durham (1) says: "Every person with an unknown cause of digestive disturbance existing over a period of time should be proctoscoped. These patients are entitled to a careful examination for infected crypts, submucous channels, and other local infections." The anus and rectum are easily accessible for examination; the instruments necessary are not expensive and are usually found in all physicians' offices.

For some reason the average patient is quite reluctant to discuss symptoms relating to the anus or rectum, unless the symptoms are so annoying as to cause a constant reminder of their presence or alarm that there may be a malignancy. Many patients take it as a matter of course that after a certain age piles will form, and that such discomforts as may develop are due to piles, and are to be expected. The common opinion is that not much can be done except by surgery, and, as the thought of an operation is unwelcome to most people, they resort to advertised nostrums. It has often been estimated that 65 per cent of all adults 45 years old or older have some form of rectal trouble.

It is becoming more and more the custom to have a general physical survey at least once a year. The insurance companies have done a great deal to educate the public to this idea. But in how many instances has this examination included an examination of the anus and rectum? In my opinion every clinic or group of physicians associated together for practice needs a physician who has given special study to medical and surgical proctology. In the majority of clinics, if some pathology is discovered in the anus or rectum the patient is referred to the surgeon, who includes rectal surgery as merely a small part of his work. There are, however, many conditions that are entirely medical in their treatment, and many that are usually treated by hospitalization and operation can be equally well if not better treated in the office.

The diagnosis of rectal diseases in their early stages is, as Tuttle (2) says, "Sometimes very difficult, inasmuch as the subjective symptoms are often referred elsewhere." Apart from the local symptoms of anorectal disease, which may be entirely absent, the symptoms forcing the patient to the physician may be quite foreign to the anorectal region.

Aaron (3), in discussing the symptoms of hemorrhoids, notes the widespread area of the subjective symptoms: "General symptoms caused by hemorrhoids include a feeling of pressure and fullness in the abdomen, sacral or dorsal pains, and nervous phenomena, such as pressure in the head, headache, vertigo, and nausea. These symp-

toms depend upon differences in the relative blood pressure in the territories drained by the vena cava and the portal vein, chronic constipation, and neurasthenia."

Also Hirschman (4), in giving the symptoms of hemorrhoids, mentions the mental depression and the fact that many patients having hemorrhoids have no pain. He says, "The patient complains of a constant sense of weight and dragging in the rectum and sacral region, and is usually more or less mentally depressed. Many patients having hemorrhoids suffer from no pain whatever." The average female patient, in giving her history will describe severe backaches, a tired-out, exhausted feeling, and then, perhaps, couple with it a recital of some symptoms of menstrual irregularity, etc. If the physician does ask about the rectum or anus, she will probably reply casually that she has had piles, but that they do not bother her now.

In this paper the frank cases of piles, fistula, and other anorectal diseases will not be considered, but only those in which the symptoms are misleading. The fact that pathology originating in the colon, rectum, or anus may influence that general economy of the body and produce symptoms entirely foreign to the origin of the disease was first forcibly brought to my attention a number of years ago in the case of a child who was thought to have pulmonary tuberculosis. She had been under the care of several physicians, and had spent one winter in California. Tubercle bacilli had never been found, but the general physical condition of the child had induced several physicians to make the diagnosis of tuberculosis. One day the mother stated that she had considerable trouble with the child's bowels. A more than usual examination was made, and an old fissure in ano was found. This was corrected and the child began to improve almost from the first day, taking on weight and losing her restlessness and irritability. Some children seem almost stoical in regard to pain. Undoubtedly this child had pain at stool, but shyness caused her to refrain from mentioning it, and this was the cause of her constipation. The constant irritation on her nervous system resulted in her irritability, loss of weight, and indigestion.

About the same time I was observing this child I had as a patient a woman about 50 years old who was under my care for the treatment of piles. I was using the injection method and she told me that after the first treatment she had a severe attack resembling "a hard cold on her chest." In three hours after the next treatment she had another attack; and had similar attacks after each subsequent injection. Since then I have observed a man with asthma who would have attacks of asthma without increased inflammation of his piles; but on the other hand, if he had any irritation of the piles, he was

sure to have an attack of asthma. The piles were removed and since then he has been better, though not cured of asthma. Several other cases of chronic bronchitis with apparently some relationship between the rectum and the bronchial tree have been observed, but none in which the relationship seemed so well defined as in the case described. Gottlieb (5), in discussing the treatment of bronchial asthma at the University and Bellevue Medical Clinics, states that the bacteriology of the stools as well as of the nasal passages, tonsils, tooth sockets, and bronchial secretion should be ascertained. He has had cases of colon bacillus anaphylaxis under observation, and cites several cases reported by others.

Women in particular have low backache as a very common subjective symptom. Many give a history of one or more operations on the pelvic organs, wearing of belts and corsets to correct posture and no relief from the backache. Most of these women have known that they have piles, or give a history of piles existing at some time, and this history has been ignored. Patients in whom some form of anorectal disease has been found and treated have often remarked on the gradual disappearance of a persistent low backache which had been constantly present.

We have evidence also of a relationship between rectal disease and nervous disorders. One patient, a woman, had been considered a neurasthenic for years. She had an irritable temper and a moody disposition. It had been seriously debated whether she should be committed to a State institution. A careful general examination was negative until the rectum was examined; here there were several polyps. The polyps were removed and now this woman is normal in every way. Durham (6) says: "A highly neurotic patient complaining of all manner of digestive disturbances, taking purgatives and complaining he never has a feeling of complete emptying of the bowel; such patient's condition is very probably due to hypertrophied anal papillae." This condition of hypertrophied papillae is much more common than is realized by the physician who does not make a routine examination of the anus and rectum. It undoubtedly is more common than polyps, and yet may be the source of severe neurotic disturbances.

Pennington (7) is of the opinion that all hemorrhoids are infected or potentially so. With this as a working basis, the physician may explain obscure conditions in many other parts of the body. It is just as reasonable to expect a focus of infection in the anorectal region to act as the exciting agent in arthritis, etc., as to expect this from infected tonsils or teeth. This premise is further substantiated by work done by others along this line. Drucek (8) says: "The coexistence of rectal disease with disturbances of other por-

tions of the intestinal tract can not always be explained on the basis of accident; and rectal disease is so often associated with foci of infection in the mouth, or with gastric or duodenal ulcer, cholecystitis, chronic appendicitis, and colitis, that it seems there must be a biological connection. The veins of the rectum and sigmoid correspond to the arterial tree, beginning in the plexus of vessels surrounding the anus and returning through the portal system and liver before entering the general circulation. This may explain the possible transmission of infection and emboli from suppurative processes in the anorectal region to these structures, and the etiologic source of some of the pathology found in the upper intestinal tract." Visher (9) has had the experience of two cases of pancreatitis and diabetes that improved by surgical treatment of the rectal conditions. He is of the opinion that infection in organs supplied by the portal vein may reach the liver by way of the portal circulation, thus causing hepatitis, which is spread by the lymphatics to the gall bladder and pancreas. Schafer (10) reports an abscess of the brain; the post-mortem showing colon bacilli as the infecting organism. The original focus in this case was a perirectal abscess and stricture of the rectum.

Goldman (11), of the Hospital for Joint Diseases, New York, is doing an immense amount of work in regard to the rectum as a focal site of infection in arthritis. In a personal letter he states he is carrying on further work in regard to the bacteriology of this field. Two of the cases reported are illustrative of this type of cases. "O. M., colored, aged 48, married, chauffeur, severe pains right shoulder, duration six months. No history previous illness or injury. On proctologic examination find internal hemorrhoids. Hemorrhoidectomy and recovery. At no time did patient receive any treatment to shoulder. J. C., age 55, married, janitor. Pain in right shoulder; unable to lift the arm from side. Proctologic examination revealed large ulcer on anterior wall anal canal. Local treatment applied. Six weeks after starting treatment patient returned to work." In my own work there has been an interesting case of arthritis in the knees and a persistent neuritis. It was decided the focal point of infection was in the rectal crypts. Application of 5 per cent solution mercurochrome soon made a change for the better and eventually cured the patient.

Disturbance of the sympathetic nervous system is recognized as a factor in causing hyperthyroidism. These cases of irritable colon or mucous colitis have a profound effect upon the sympathetic nerves. Jordon and Keefer (12), in an article on the Irritable Colon, in which 22 cases of irritable colon have been studied, note in particular its frequency of occurrence in patients complaining of digestive

symptoms, and the association of changes in tonus and irritability of the colon with symptoms suggestive of intraabdominal organ lesions, of cardiac disease, and systemic nervous disorders. Also Kemp (13), in his chapter on mucous colitis, says: "These patients are markedly neurasthenic and morbidly self-conscious; in appearance they are usually emaciated, with history generally of considerable loss of weight. There has been obstinate constipation of long duration, with occasional intermittent diarrhea. Palpitation, dizziness, disturbance of the genitourinary system, hysterical symptoms, anemia, headaches, and gastric disturbances of various types are present." From these observations of Keefer and Kemp one may raise the question, Was the patient's hyperthyroidism benefited by the change in intestinal flora, which gave relief from a toxic condition or by relief from disturbance of the nervous system? It is enough to bring evidence that profound disturbance of the nervous system may be brought about by conditions often not recognized.

In regard to colon infection, it should not be forgotten that since the Spanish-American War and World War mild amebic infection is more common than generally supposed. Many cases with indefinite pains in the abdomen, with or without constipation or diarrhea, are due to amebic infection.

During the 1929 meeting of the American College of Physicians, Capt. F. E. Sellers, Medical Corps, United States Navy, demonstrated several cases of psoriasis. In some the skin was entirely clear of lesions, and in others the skin was in process of being cleared. The only treatment used was retention enemas of buttermilk. Captain Sellers did not attempt to give a reason why these cases were cleared up by buttermilk enemas. It is my opinion, however, that the high retention enema, of a substance rich in acidophilus bacilli, so changed the flora of the bowel as to stop a toxic process affecting the skin.

#### CONCLUSIONS

1. All general examinations such as periodic health surveys or efforts to establish the etiology of an obscure disease should include a thorough proctologic examination.
2. Foci of infection in the colon or anorectal region may have as profound an effect on distant organs as infection in the upper alimentary or respiratory tracts.

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#### THE DISTRICT MEDICAL OFFICER

By R. P. CRANDALL, Captain, Medical Corps, United States Navy

The duties of a district medical officer as laid down in the Manual of the Medical Department, United States Navy, comprise a much greater wealth of detail than is at first apparent on a casual reading of the paragraphs pertaining thereto. This especially pertains to the third naval district.

On receipt each week of public health reports from the United States Public Health Service and the daily circular of the department of health, the city of New York, bureau of preventable diseases, detailing the number of new, continued, and terminated cases of contagious and infectious diseases, he is prepared to keep the commandant informed as to any precautions or measures necessary to be taken for the protection of the Navy personnel of the district.

He should be in touch with every naval medical activity in the district and be prepared to inform the commandant on any subject relating hereto and to advise with him as to the handling of any emergency that may arise.

An important duty is to investigate the cases of enlisted men on liberty or leave from different ships and stations who have reported in sick or are reported from civil hospitals as sick or injured. If after investigation their condition warrants, they are transferred to a naval hospital. If, however, a case is too serious for such transfer, authority is given for his retention at home or in a civil hospital until such transfer to a naval hospital is advisable. During this time frequent inquiries are made regarding the patient's condition.



Some of the cases are transferred immediately under the jurisdiction of the commandant, third naval district, and others remain attached to the ship or station concerned. Full details are communicated to the ship or station as to the circumstances of the case involved. The necessary papers as to expense are forwarded to the Bureau of Medicine and Surgery for approval. Much correspondence is involved in many of these cases due to misunderstanding on the part of the Navy personnel or civil authorities in forwarding the necessary forms or information.

In the event of the death of an officer, enlisted man, or reserve in the district, the facts must be verified officially and death certificates on the official forms forwarded to the Navy Department in order that the records of the deceased may be officially closed. The necessary information is at times most difficult to obtain, involving much lengthy correspondence with the civil authorities when such cases occur and might even require the presence of the medical representative in court to identify bodies of personnel who have been killed or seriously injured while on leave, liberty, or duty.

The members of all boards requiring medical officers, such as medical and property survey, pension, inquiry, investigation, inquest, etc., are named by the district medical officer, and the reports of these boards are handled through his office.

The greatest call on the time of the district medical office is in the making of physical examinations, which comprise not only transfers, reenlistments, and discharges in the regular service but also those of the Naval Reserve, including enlistments, merchant marine reserve, civil service, life insurance, recall to and release from active duty, for appointment and promotion, preliminary examinations for Naval Academy entrance, and pension and compensation act cases. He must also arrange for the special aviation examination at a naval hospital or a station designated to do these examinations. Physical examinations are made in the case of officers of the Naval Reserve every four years and also of the Naval Reserve enlisted personnel, classes F3 and F4, who are classified in addition as to sea, shore, and unfit duty. The major part of the Fleet Naval Reserve and retired officers are admitted through the district medical office for hospitalization or treatment when requesting treatment or hospitalization. The chief burden also of the annual physical examinations of officers falls on him, especially in the third naval district, where a large number of officer students attend the various universities, medical schools, and instrument factories in and about the city of New York. The care, treatment, and hospitalization of these officers naturally falls on headquarters, where their health records are kept during their school courses.

The treatment of civil employees, usually first aid, occupies considerable of the time of the district medical office, as there are over 1,100 employees attached to headquarters and the naval supply depot, Brooklyn, N. Y. At times as many as 40 or 50 a day will seek treatment for some ailment or request information or advice.

Officers and their families about to take passage for the Far East frequently apply at headquarters for typhoid inoculation and vaccination, as called for by transport regulations. They are always advised further as to diet, clothing, and hygiene on their trip.

The families of officers, temporarily residing in or passing through New York City often request advice as to the choice of a specialist, hospital, special treatment, school, or sanitarium. This advice is always most willingly given and all possible assistance rendered in making the necessary arrangements for their care and comfort. Wherever possible, an officer of the Naval Medical Reserve Corps is recommended, especially if such officer has an office in their immediate vicinity. To this end it is most desirable that a district medical officer keep in close touch with the medical profession of his locality and be familiar with the location of all general and special hospitals.

He should especially follow up new construction in order to obtain a desirable assignment of beds, and when such construction is completed should arrange to add these to his list of beds available in time of national emergency.

The handling of health records alone requires constant work and attention in order that they may be expeditiously forwarded and correctly filed and indexed. All medical reports from medical activities are examined and commented on when necessary and errors rectified.

Night calls from radio-compass stations must be answered and directions given as to treatment or transfer to civil hospitals.

The district medical officer, being a member of the staff of the commandant, may be assigned to represent the commandant at official and semiofficial functions, such as entertainments for visiting foreign naval officers, receiving distinguished visitors, attending reviews and parades, medical and health society meetings, military balls, and other social functions too numerous to mention. (Attention is called particularly to New York City, which is known for its numerous entertaining, receiving, and other functions.)

He is also called upon to speak at dinners and banquets given by medical clubs and societies to foreign medical men visiting the city and to assist in showing them the hospitals and medical institutions of the locality, especially the naval hospital and medical supply depot and other details of the naval establishment in which they may be interested.

He should never neglect an opportunity to keep in touch with the medical profession generally, to the end that the Medical Corps of the Navy may be benefited by such association.

Finally he must attend the weekly conferences held by the commandant and his heads of departments in order that he may bring to his attention the needs, necessities, and problems of the Medical Department that constantly arise.

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#### TROPICAL INFLUENCE ON DENTAL AND ORAL DISEASE

By P. A. McCOLE, Lieutenant, Dental Corps, United States Navy

In a study of dental conditions in relation to tropical diseases, it is of note that little other than the reporting of oral manifestations of certain systemic diseases has been written.

Stitt, in his latest work on Diagnostics and Treatment of Tropical Diseases, comments on the absence of reports in the literature relating to the manner in which dental diseases in the Tropics may vary in frequency or character from those encountered in temperate climates. This he regards as remarkable in view of the influence of dietary and hygienic conditions on the teeth, and considers it as being due possibly to lack of time or energy on the part of dental surgeons practicing in the Tropics.

Until recent years comparatively few accredited members of the dental profession have located with any degree of permanency in the Tropics, and in view of this fact it appears that little opportunity to study pathological manifestations in relation to dental diseases in those climes existed. It is probable, also, that the lack of literature relating to this subject may be explained by the fact that the professional services of the few well-educated and competent dental surgeons who provide dental treatment to Caucasian clientele in tropical countries are so much in demand that the strain of attendance to large dental practices, arduous in any region, and particularly so in the Tropics, tends to prevent the additional work of writing up reports of conditions met with which may vary from those encountered by practitioners in Temperate Zones.

Reports of recent investigations would indicate no particular difference in the incidence of dental caries in the Tropics from that noted in zones of lower temperature. White persons newly transplanted to the Tropics frequently report a more rapid progress of dental disease, but a study of all available reports on the subject indicates that under hygienic conditions the progress of caries in the Tropics is not abnormal. Dental officers frequently encounter patients who date the appearance of dental caries from a tour of tropical duty, but no cogent evidence of an appreciable increase of

dental disease appears to have been observed or reported by Army or Navy dental surgeons who have served with our forces in the Tropics. It is of note that the view often prevails among newcomers in many geographical locations and of varied climates that ill health is an accompaniment to life in new surroundings, and while evidence is available that a prolonged stay of white peoples in tropical lands often exerts a deleterious effect on the general system, yet no particularly baneful influence upon tooth structure, or increase in the incidence of dental caries, has been attributed to a tropical existence.

In comprehensive examinations of mouths and teeth of Filipino children in 1902, little material difference was observed by Ottogy (1) from the teeth of children of the white race; but in Filipino adults, he observed a better condition of the teeth as a whole than found in the average white adult. He reports that susceptibility to caries, which in Caucasians is diminished after the twenty-fifth year, is considerably diminished in children of the Tropics after the sixteenth or eighteenth year. This he believes may be due to the habit of smoking, an indulgence common to both sexes in the Philippines, and the apparently partly beneficial influence of betel-nut chewing, a custom to which the populace of some tropical countries is addicted.

Natives of many tropical lands, from long contact with northern peoples, have accepted with avidity the soft foods of the white race, and have discarded, in so far as possible, the coarse foods of their ancestors. An increase in the incidence of caries has resulted in localities where this dietary change has occurred.

It is a generally accepted theory that newcomers of the white race to the Tropics must undergo a period of acclimatization of varied duration before becoming inured to the new climate, and during this process the diseases affecting the soft tissues of the mouth differ in some respects from what is observed in those accustomed to tropical life.

Virulent infections of the gingivae, and unusual inflammatory conditions of the attaching tissues of the teeth have been reported in persons not indigenous to the Tropics. Persons affected with pyorrhea, on reaching the tropics frequently report that the disease becomes aggravated and that relief is not readily attained through treatment. It appears that while this condition is found occasionally among those who have been fully acclimated, it is found principally during the process of acclimatization, and usually follows either the general depression or systemic disturbances which are manifested in many soon after arrival in the Tropics.

The habit of betel-nut chewing among tropical natives results in severe infections of the oral mucous membrane. This habit, begun

in childhood, exerts a most harmful effect on the soft tissues before adult life is attained. The betel nut, a small orange-colored fruit, inclosed in a fibrous husk, is really the seed of the fruit which grows on the areca catechu tree. The nut is chewed in combination with a piece of lime and a bit of the leaf of the betel palm and imparts to the teeth a dense reddish-black deposit. Serious and chronic changes in the gingivæ and soft tissues of the oral cavity result from the habit. Extensive examinations of the mouths of betel-nut chewers have revealed no evidence of tumors or cancers of the mouth or jaws. While some beneficial effects may result to the teeth from betel-nut chewing, the habit can not be encouraged when consideration is accorded to its serious destructive effect on the gingivæ and soft tissues.

The opinion appears general among dental officers of the Army and Navy who have had tropical experience with American personnel, that the defense forces of many individuals in the tropics appear inadequate to effectively combat such oral infections as are produced by microorganisms of the Vincent types, and that the response to the usual methods of treatment is much delayed, as the soft tissues, the mucous membrane and gums of individuals not indigenous to the tropics appear more susceptible to disease and yield more slowly to treatment. This delay in healing is true also in tissues after removal of teeth, in diseases of the pulp, and in pyorrhea.

Due probably to the diminished resistance of patients affected with malaria or dengue, to the enervating climate, or to dietary insufficiencies, a marked increase in the occurrence of alveolar abscesses and oral periodontal infections has been noted. It is probable that the parasite initiating the systemic disturbances paves the way, through lessened resistance, for other species to participate as secondary invaders, this resulting in an increase in oral infections and in abscessed teeth. A delayed response to accepted methods of treatment in alveolar abscesses and periodontal infection has been reported by many observers, and treatment in such conditions, to be effective, must be persistent and thorough.

To summarize, it appears that no noticeable increase in incidence, or variation in character, of dental caries is observable in the white race in the Tropics, but that an increase in alveolar abscesses and in the number and virulence of oral infections has been observed, as has also a delayed response to accepted methods of treatment of oral diseases and pulpless teeth, and an increased susceptibility to post-operative infection.

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MEDICAL MYCOLOGY<sup>1</sup>

By G. W. COOPER, Lieutenant, Medical Corps, United States Navy

Necessarily, of course, each country and climate has its own nomenclature and description of fungi indigenous to each area. The pioneer work in England is well arranged, through fragmentary of course, by M. C. Cooke in his "Handbook of British Fungi" in two volumes, 1871, Macmillan & Co.

The pioneer work in the United States is comprehensively and quite completely included by Castellani and Chalmers in their *Tropical Diseases*, 1922.

The *basidiomycetes* includes the mushrooms, toadstools, and important plant parasites, as the rusts. The *myxomycetes* are the slime molds and, like the *basidiomycetes*, do not concern us in medical science.

Let us return to the *hyphomycetes*, which species we have said to be widespread and malignant invaders of our cultivated crops as well as troublesome causes of diseases in man. Most parasitic molds of man belong to this order.

## HYPHOMYCETES (Deuteromycetes)

The species of this subclass (order, of certain authors) which are of concern to the practicing physician are those to be remembered by their scientific specific name. These are as follows:

1. *Malassezia furfur*.
2. *Monilia* (or *Oidium*) *albicans*.
3. *Microsporoides minutissimus*.
4. *Discomyces bovis* and *Discomyces hominis*. (Latest terminology is *Actinomyces hominis*.)
5. *Discomyces maduræ*. (Latest terminology is *Actinomyces maduræ*.)
6. *Sporotrichum beurmanni*.
7. *Nocardia pelletieri*.
8. *Trichosporum giganteum*.
9. *Monilia candida*.

I have given these in about the order of frequency found in routine clinic work in the United States, except that *sporotrichosis* is reported more commonly than *actinomycosis* in parts of the Southwest and the upper Mississippi Valley. The *hyphomycetes* have been recently named *deuteromycetes* by some writers, but are in reality a subclass of the greater class, *deuteromycetes*, which latter class term is synonymous with "Fungi imperfecti."

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<sup>1</sup> This is the second of three lectures delivered at the Naval Medical School in November, 1929. The third lecture will appear in the October, 1930, number of the BULLETIN.

*Malassezia furfur*.—This infection, known as pityriasis versicolor or tinea versicolor, is common in both temperate and tropical climates. The mold is also known as *microsporon furfur*. The spores are small in size. Dirty yellow spots appear on the covered parts of the body and are especially common on the chest. The disease is very refractory to treatment. The small spored fungi are usually more intractable than the larger.

Scrapings show a thick, short, branched mycelium with the hyphæ connecting groups of many spores (conidia), about 30 to 40 in the groups which are slightly separated and resemble connected bunches of grapes. The mycelium is septate and 3 to 4 micra in diameter. This, in general, is the structure of other species of the genus *malassezia*. None of them grow well on artificial media.

The "bottle bacillus" causes one form of pityriasis of the scalp and may be quite easily cultured, in this respect differing from *malassezia*, but in most respects it resembles the latter, being in reality a fungus rather than a bacillus. I have experienced no difficulty in culturing it but several attempts to culture the *malassezia* have been devoid of any trace of growth.

In culturing fungi from skin lesions, the lesion is washed first with benzene, next with green soap and water and then covered with gauze soaked in 70 per cent alcohol for 1, 5, and 10 minute periods. At the end of each period 1 glucose and 1 maltose Sabouraud's agar slant is inoculated. The 70 per cent alcohol is to inhibit the growth of bacteria present, since these are the confusing contaminations so commonly occurring on fungous cultures, especially the *B. subtilis* Cohn. Exposure to alcohol for 1, 5, and 10 minutes is merely arbitrary in an attempt to find the exposure time at which all bacteria are inhibited; fungus is uninfluenced by the alcohol during these short exposures.

Synonyms of *malassezia furfur*: *Microsporon furfur*, *sporotrichum furfur*, *oidium furfur*, *oidium subtile*.

*Monilia albicans*.—While this is in commoner usage, another current designation is *oidium albicans*. It has also been called *endomyces albicans*, *saccharomyces albicans* and *syringospora robini*. It was discovered by Robin in 1853 as a causative agent of thrush or muguet. Various species of *edomyces* and other species of *monilia* also cause the condition.

This fungus was cultivated in several experiments for the purpose of comparison with a certain unknown fungus recently isolated which which was thought to be a cryptococcus of the vegetable family, *saccharomycetaceae*. Now the *monilia albicans*, while given biological classification in the class *hyphomycetes* (Stitt), bears great morphological resemblance to both the true yeast (*saccharomyces*

*cerevisiae*) and the species of genus *cryptococcus*, due to the terminal mycelial segments and lateral globular conidia, both of which reproduce by budding and become detached, now resembling yeasts. The organism is usually encountered as the elongated yeastlike cell showing budding, but, under adverse cultural environment, one may find that a mycelium with hyphæ and spores have devolved. For this and certain other reasons it appears to the writer that this and related organisms should occupy a distinctive position in the classified biological scale between the true yeasts and the true molds, rather than be placed in the class *hyphomycetes* and given with the lower order of molds or "fungi imperfecti," a final label as is now held by certain authorities. In fact, so close is the resemblance to yeasts at times that one of the synonyms in the literature is *saccharomyces albicans*.

Exact cultural studies are on record. It ferments sugars, but to a lesser degree than yeasts, and grows well on gelatin and agar, in the presence of free oxygen and upon slightly acid media. Two outstanding strains are said to vary as to gelatin reaction; the large-spored type causing liquefaction and the small-spored type without change of the gelatin. Hewett states that the organism liquefies gelatin while other authorities claim the reverse. (The specimen isolated by the writer did not, at least over the 6 weeks of observation, show gelatin liquefaction. Spores observed on old desiccated cultures appeared to be relatively small.) It appears only fair, however, in the face of so many conflicting reports, to conclude that both reactions are exhibited by various strains. Several writers record it as clotting milk; others say it does not. The writer's organism showed clotting of milk after 120 hours, the medium having shown a faint trace of acid formation at 24 hours and remaining acid. Castellani and Chalmers state that after a time the milk clots, but they do not give the time factor.

*Monilia* also resembles the *endomyces* which in turn resembles the two other genera of *saccharomycetaceae*, *saccharomyces* and *cryptococcus*. *Monilia*, however, does not show the *asci* and *endospores* of the *endomyces*. In cultures there are both budding yeastlike forms and a mycelium. A white cottony growth results on Sabouraud's medium. Stitt gives slow liquefaction of gelatin as a character of this *monilia* which, as I have just pointed out, is in disagreement with the studies of one strain isolated and observed for six weeks by myself, and contrary to the findings of other workers. However, Castellani regards the true *M. albicans* as a slow liquefier.

*Culture reactions*.—Acid formed on saccharose, galactose, maltose, levulose, glucose, and litmus milk. The milk is clotted. Gas is formed on glucose, levulose, maltose, and galactose. Broth remains clear with a thin pellicle. Peptone water is clear.



*Treatment.*—That of Faber and Clark is the latest well-accepted one. A water gentian' violet solution (1 per cent and not over 2 days old) used b. i. d.

*Pseudomonilia ashfordi.*—This organism resembles closely the *monilia albicans*, but, according to Ashford, is quite distinct from it. He has isolated it from the feces of sprue patients and states it to be common in the bread of certain West Indian countries. *Monilia septicemia* has been produced in rabbits with the organism and stomatitis by feeding it to various animals. Visceral lesions resulting from the septicemia cases do not show gross pus formation.

Various fungi have been found in the mouth and intestines of sprue patients. Yeasts and *monilia* are the most common. *Monilia* such as *M. enterica*, *M. faecalis*, *M. intestinalis*, *M. rotunda*, and *M. decolorans* are reported by Castellani and Low, but, in the Tropics, these types may also be found in stools of normal persons but less often and in lesser amounts.

*Sprue.*—Bahr reported *monilia albicans* in the deep lingual, esophageal and intestinal tissues of cases of sprue. It is thought now that the Bahr organism was without etiologic relationship to the disease.

The Ashford *monilia* is now generally accepted as authentic, but only as a secondary invader, rather than the etiologic agent. Examination of stools for the fungus is by the method of Bastedo and Farmulener or may be done as follows: The thin, white, frothy stool is passed through 5 to 10 layers of gauze and the filtrate plated on gelatin and Sabouraud's maltose agar, 1 cubic centimeter is added to the usual test-tube of gelatin and plated at 22° C. for 24 to 120 hours, being examined at 24-hour intervals for types of bacteria. A second cubic centimeter is plated on Sabouraud's agar and a third on gentian-violet agar for 6 weeks and examined for fungi at intervals. The monilias grow better on acid medium. The number of colonies per cubic centimeter is estimated by dilutions.

*Morphology of the Sprue pseudomonilia.*—The organism is also known as *monilia psilosis* and appears very closely related to the *monilia enterica* of Castellani. It is a large, round, yeast-like cell, 4 to 7 microns in diameter. The protoplasm is granular and vacuolated. On Sabouraud's agar it grows as a pale, greenish-creamy, elevated mass and shows a mycelium which usually penetrates the medium. Gelatin stab is diagnostic, giving what Ashford calls an inverted Christmas-tree figure.

*Microsporoides minutissimus.*—The fungus is one of a variety found in *erythrasma* which resembles Dhobie itch, one of the commonest intractable skin complaints of the tropics. It is also known

as *nocardia minutissima*, *microsporum minutissimum*, *M. gracile*, *discomyces minutissimus* and *oospora minutissima*.

*Morphology*.—The mycelium is of smaller diameter than most fungi (0.6 microns thick and not ramified very often) and the spores quite small. Both are easily found at the onset of the disease but are reduced as the process advances. In the advanced stage the mold may be practically absent. It is difficult to grow but has been reported cultured by at least three workers. This explains the negative results so frequent upon cultures and examinations. Symbiosis of this fungus and a coccus has been reported by Stitt. The mycelium segments are easily dissociated and then resemble bacilli or streptobacilli.

*Diagnosis*.—Erythrasmic patches are fawn or dark red in color and show a fine pityriasic shedding. The border is not limited by a raised red edge as in Dhobie itch. The latter lesion has a festooned contour. Intertrigo is also common in the Tropics, especially in corpulent people, but the lesion is not festooned and does not show the raised border. The fungus found is a *Saccharomyces* when a mold is present. Usually there is no fungus found.

*Epidermophyton cruris*.—This trichophyton is considered by Castellani as the chief cause of Dhobie itch. It is also known as *epidermophyton inguinale* and *trichophyton cruris*.

*Morphology*.—The mycelial segments are rectangular, branched, and often show a double contour. They are 3.5 to 4.5 microns thick. Degeneration forms are met with in chronic cases; strings of ovoid, constricted or sausage-shaped forms.

Blunt septate spindles borne on aerial hyphæ are diagnostic.

*Method of microscopic diagnosis*.—At least two methods should be tried to obtain a view of this as well as any other fungus. Method 1 follows:

Mount scrapings of the lesion in a drop of 20 per cent sodium hydroxide on a thin cover slip and make the usual hanging-drop with vaseline ring around a hollow glass slide. A 10 per cent solution may also be used. If free pus is examined, use 40 per cent hydroxide.

Specimen is taken by both superficial and deep scraping of the lesion with a cataract knife or larger scalpel.

Method 2 is as follows: To a drop of 90 per cent ethyl alcohol on a slide add a particle of the scrapings or culture by means of a right-angled platinum hook or a teasing-needle. Then add one drop of the following solution: Lactic acid, phenol and sterile water each two parts, glycerine four parts. Cover with a thin cover slip. This process is used by mycologists and is said to prevent swelling, shrinking or drying of the fungus cells besides clearing the prepara-

tion of air by means of the alcohol. Human, dog, and guinea pig inoculations have been unsuccessful.

*Most recent treatments of epidermophytosis.*—Recent work has shown generally satisfactory results in the treatment of *epidermophytosis interdigitalis* of the feet, especially the chronic cases and those showing secondary, pyogenic infection, by means of the fuchsin paint of Castellani. The formula is also useful in some cases of pruritis ani and pruritis vulvae of fungoid origin. The fuchsin paint, like the 1 per cent aqueous gentian violet for the *monilia albicans* as advised by Faber and Clark, may be tried empirically on most any surface mold infection unresponsive to other treatments. Before any treatment is applied, however, the affected parts must be scrubbed with warm water and soap by means of a soft-bristled brush, and dried. Larger vesicles must be clipped or opened.

The analin red paint is as follows: Saturated alcoholic solution of basic fuchsin, 10 cubic centimeters; 5 per cent aqueous carbolic solution 100 cubic centimeters. Filter and add boric acid, 1 gram, and after 2 hours add 5 cubic centimeters of acetone. Two hours later, 10 grams of resorcinol. Keep solution in a dark bottle with glass stopper.

If these measures fail, the aqueous solutions of thymol, cinnamon and clove, in the order named, may be tried. These have proven superior to the other common medicaments for fungous diseases according to the work of Myers and Thienes and to evidence in the laboratory studies of Kingery and Adkisson. Certain volatile oils and stearoptens have proven superior in these tests on both the approximate killing power and the growth-restricting effect. Deeks made an ointment for clinical application of these facts. His original formula contained salicylic acid 4, bismuth subnitrate 10, mercury salicylate 4, oil eucalyptus 10, lanolin and petrolatum aa qs ad 100.

The *epidermophytosis interdigitalis* cases of the hands and feet such as reported by Butler, Houghton, and Cooper are even more common in the Tropics than true Dhobie itch. They are common in the temperate zones and are caused by strains of *epidermophyton* almost identical to that of Dhobie itch. In fact the strains may be identical in the two infections. Incidence of the *epidermophyton digitale* infection is almost 100 per cent in those who persist in using public showers or baths and neglect to dry their feet well between the toes. Treatment is as just described for Dhobie itch. The condition is often called pompholyx, dyshidroses or eczema marginatum of the groin or eczematoid lesions of the hands and feet.

*Discomyces bovis.*—Commonly known as the ray fungus of actinomycosis. Other generic names are *nocardia bovis* and *actinomyces*

*bovis*. The condition is a granuloma and attended by chronic sup-  
puration in cattle. There is formation of much granulation tissue.  
The pus usually shows small dirty-yellow granules about 0.5 to 1  
millimeter in diameter. If not found free in the pus they may be  
obtained sometimes by curretting the sinuses of the lesion.

*Diagnosis*.—Crush one or more granules between two slides or  
between a slide and a cover slip. Make two preparations. One is  
stained by Gram and the other is examined in the fresh, unstained  
state. The threads are Gram-positive but not acid-fast.

The central network of mycelium is Gram-positive. Thread-like  
rays radiate to the periphery of animal tissue specimens where the  
outer margin of the circle is composed of bulbous processes or  
“clubs.” The latter are Gram-negative. The threads are 10 to 20  
microns long and 8 to 10 wide. Brumpt demonstrated the “clubs”  
to be young active forms which disappear in old granules.

The fresh preparation shows a crushed hyalinelike mass for  
each granule on the slide. Radial striations and mycelium are

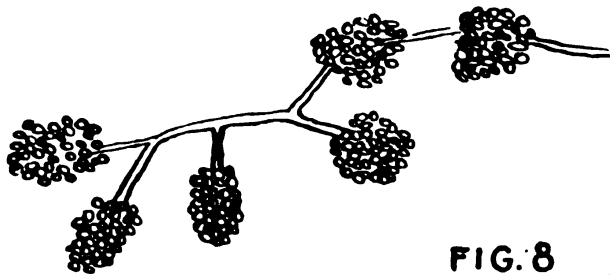


FIG. 8  
*Malassezia furfur*  
(in Tissues)

poorly visible but are usually made out. The peripheral “clubs”  
are more distinct in animal tissue. Cultures show a thin branching  
mycelium, 0.4 to 0.6 microns in thickness.

*Diagnosis* can be made under the low power.

*Cultural*.—The mold is best cultivated by deep stab culture on  
Sabouraud's maltose or glucose agar, but surface growth also occurs.  
Plain sugar agars may also be used. Mostly sediment growth results  
in bouillon as the organism grows best with but partial utilization of  
hydrogen, oxygen, or nitrogen of the atmosphere. It is, however,  
an aerobe. On solid media the growth is dry and chalklike. There  
is peptonization of milk, fibrin, gelatin, and egg albumin. Growth  
is fairly rapid on glycerinated agar and shows a scant, coarsely  
granular, brown-yellowish colony. Colonies coalesce as they increase  
in size.

*Pathogenicity*.—Inoculation of pure cultures on laboratory ani-  
mals has not been successful in reproducing the disease. It has  
been reported as growing on certain cereals as a saprophyte.

*Discomyces madurae*.—Many species may cause the same clinical entity known as madura foot. The yellow "fish-roe" granules are discharged from suppurating sinuses. Bones, cartilage, and joints may be destroyed. The hand or some other part of the body may be affected although this is quite rare. The lesions and granular discharge from sinuses resemble the actinomycosis lesion. De Beurmann's case of black madura foot was reported due to *Sporotrichum beurmanni*.

Usually but one species is found in each case although two or more may be present. The common species found is *discomyces madurae*, the French name of the same species which the English call *nocardia madurae*. The English employ the generic name *nocardia* instead of *discomyces*. The Bergey manual gives *actinomyces*.

*Diagnosis*.—Procedure as above given for *discomyces bovis*. The granules are apt to be larger (from 0.5 mm. up to 0.5 cm.) than in the bovis species.

*Morphology*.—As for the *D. bovis*, there is in tissue lesions of humans a central dense mycelium and the usual "clubs" at the outer border of the circle configurations. The mycelial threads are smaller in thickness, 1 to 1.5 microns; these are gram positive. The ends of these threads break up into conidia which are ovoid, 1.5 to 1.75 microns. The mycelium is straight or with a few spiral forms, and shows branching mycelium and hyphae.

*Cultural*.—Much as the *D. bovis* except that the *D. madurae* is a more decided aerobe. Neither is there liquefaction of gelatin. The gelatin stab shows a cream-colored surface growth, while plain agar shows a profuse cream-colored growth. Broth shows slight turbidity with large, globular masses.

*Pathogenicity*.—Not pathogenic for animals.

*Actinomyces hominis Bostrom*.—This is the human type of *discomyces* or cause of actinomycosis in man.

The Bergey manual gives the following account of the *A. hominis Bostrom*:

Straight, branching mycelium with straight hyphae. Tissues show the club-shaped forms. Conidia are present. Positive by Gram's stain.

There is abundant, spreading, cream-colored growth in gelatin stab. Liquefaction occurs.

On synthetic agar there is a thin, spreading, white to yellow growth becoming brown. Aerial hyphae are white with olive tinge.

On starch agar the growth is yellowish and spreading while there is also a yellowish growth on plain agar.

Dextrose broth shows a thick, orange-colored ring.

Litmus milk shows an abundant, cream-colored surface growth, coagulated, peptonized, becoming alkaline.

Potato gives an abundant, yellowish to orange wrinkled growth, becoming brown.

Nitrates are reduced to nitrites.

A nonsoluble pigment is formed.

Milk and gelatin are peptonized.

Starch is hydrolyzed.

The organism is aerobic but microaerophilic.

Growth occurs best at 37° C.

*Classification.*—Because of the presence of mycelial threads and conidia the nocardias were formerly considered as species of *hyphomycetes*. The Bergey manual of 1923 records 64 known species of *actinomyces* and places them in the genus *actinomyces* Harz, 1877, of the family *actinomycetaceae* Buchanan, 1918, order *actinomycetales* Buchanan, 1918, class *schizomycetes*. This is the latest concept as to the biologic relationship of the ray fungi.

*Definition.*—*Actinomyces*, in general, are organisms growing as a much-branched mycelium which may break up into segments which function as conidia. Sometimes parasitic, with clubbed ends of radiating threads conspicuous in lesions in the animal tissues. Some species are microaerophilic or anaerobic; all are nonmotile.

*Clinical comment.*—Various pathologists have reported a variety of *actinomycetes* in clinical conditions such as multiple abscess of the muscles, kidney, liver, lungs, tonsillar abscesses and suppurative appendicitis. The kidney lesions are beautifully shown in a recent case from Great Lakes Naval Hospital.

Foulerton in 1906 reported the *nocardia hominis*, also known as *streptothrix hominis*, in a case of multiple abscesses. The *actinomyces* also appeared in the patient's sputum. Ridet, in 1911, appears to have reported the same organism as *oospora hominis*. Foulerton has reported cases of his Type III *nocardia hominis* isolated from appendicitis.

Others have been isolated from epidemic pneumonia of calves, chronic bronchitis and obscure chronic lung diseases, pulmonary tuberculosis, cerebral abscess, and "diphtheria" of cattle attended by multiple sclerotic abscesses. The striking point of incidence of the species of *actinomyces* is the frequency with which they have been reported from the lung conditions of man and cattle which resemble chronic phthisis.

It is interesting and will be new to you to learn that the native habitat of most of the species recorded in the Bergey manual is ordinary top soil and that some species, nonpathogenic to man so far as is known, are commonly found there. For example, *actinomyces scabies* (Thaxter) Güssow, is the cause of "potato scab" in the United States. At least five other species have been isolated from types of scablike diseases of potatoes. One species was reported

from a disease of sweet potatoes and another as an air contaminant of an agar plate.

*Sporotrichum beurmanni*.—This organism, discovered by De Beurmann, causes one of the black varieties of mycetoma, commonest species found in France, in which the sinuses give off the black gunpowderlike grains. Lymph glands and subcutaneous tissues often show gummalike lesions. These black cases are rare in the United States but the commonest type is that found in the upper Mississippi Valley and the Southwest and due to the species, *S. schencki*. The nodules are hard, violaceous, and irregular in contour.

*Histopathology*.—No matter which species of the nine on record causes the lesions, there is one of three pictures as a result. These are: (1) The tuberculoid type with the presence of giant cells and epithelioid types of cells; (2) the lympho-connective tissue type or syphiloid reaction which resembles the gumma; (3) polymorphonuclear or resembling more an acute type of cellular infiltration.

*Clinical diagnosis*.—The commonest types of gross lesions are: (1) The sporotrichic chancre with regional lymphangitis but with fair or good localization of the process.

(2) The widespread ulcerating type with often wide variation in the nature of the lesions such as crateriform ulcerations with fungating bases, furunclelike pus pockets, acute inflammatory localizations, syphiloid (gummalike) or tuberculoid areas.

(3) The unmixed typical widespread gummatous lesions of the lymph glands or subcutaneous tissues.

(4) The deep or nonsubcutaneous type, with lesions of the viscera, bones, joints, muscles, mucous membranes, and organs of special sense.

(5) Cases of generalized or systemic sporotrichosis are rare but are on record.

(6) DeBeurmann's case of black mycetoma (madura foot) showed the *S. beurmanni*.

A presumptive diagnosis can be made on this mixed appearance of the lesions or on the hard gummalike lesions with later a cup-shaped softening of the nodes and ulcerations showing violaceous edges. And most important of all, the patient shows little if any impairment of general health.

Definite diagnosis is made only by cultural procedures on Sabouraud's agar or other sugars on which the mycelium develops. The yeastlike spores are scarce in the pus and not commonly found by direct smears; they may appear as bacilloid bodies.

*Diagnosis*.—As for the types of *discomyces* given above, mount a drop of the pus in 40 per cent sodium hydroxide to clear it. Cultures must be made, as the yeastlike spores are few in the pus.

*Morphology.*—The mycelium is thin, about 2 microns, and shows branches in all directions. The spores are 5 to 10 microns long and are oval in shape. They are very numerous and occur in grapelike clusters at the end of conidiophores. Typical fructification inside the blood capillaries has been observed by Pinoy in general infections.

*Cultural.*—Growth occurs readily on sugar media, the growth being white, and cottonlike at 48 hours and showing a dense mycelium. Sabouraud's medium is even better. Growth in the tissues is by budding of the oval yeastlike spores and without mycelium. Growth is profuse on potato and shows brown or black pigment at times. Incubate at room temperature.

*Pathogenicity.*—This species causes most of the cases of sporotrichosis in Europe and is very pathogenic to rats and mice. Nine species have been described in man and they are morphologically very closely related. One species, the *S. asteroides*, shows peculiar radiate bodies in the diseased tissues and can be diagnosed on this finding alone. The rat, mouse, cat, monkey, and guinea pigs are all susceptible to one or more of these nine species by subcutaneous or

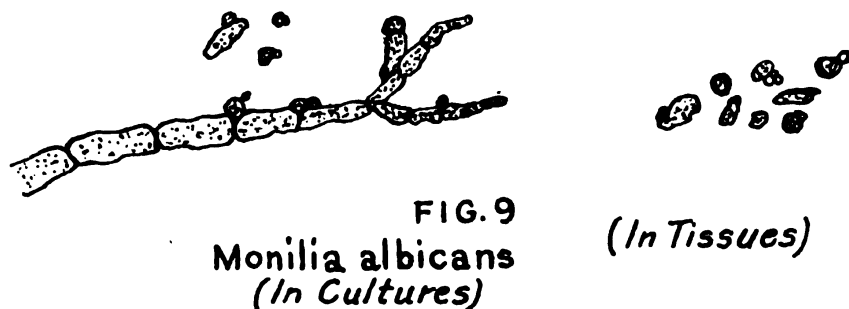


FIG. 9  
*Monilia albicans*  
(In Cultures)

(In Tissues)

intraperitoneal inoculation. Spontaneous cases have been reported in the dog and mule. Most animals appear susceptible.

*Nocardia pelletieri.*—This fungus is also a *discomyces* and causes a white madura foot, not uncommon in parts of Asia and Senegal Africa. The grains discharged in the pus are smaller than those of other species and are white or yellow in color. Certain authors report this fungus as a cause of a red mycetoma also.

*Diagnosis.*—As given for the above species of *Discomyces*.

*Morphology.*—Closely related to the *nocardia madurae* but it shows more abundant sporulation. The mycelium is thin, delicate, and easily dissociated. Some mycelial threads appear as strings of cocci, Gram-positive, nonacid-fast. Club forms are rarely found in tissues.

*Cultural.*—The colonies are small, coral-red and brighter red than for the *N. Hominis*. It grows slowly and with difficulty but has been grown on Sabouraud's agar.

*Other species of discomyces.*—There are many other species as causes of white, yellow, and black mycetomas. The term mycetoma



might be applied to any tumor of fungous origin but has been arbitrarily applied to the lesions due to *nocardia* or *discomyces*. Castellani uses the generic name of *nocardia*.

*Trichosporum giganteum*.—This fungus causes a disease of the hair known as "Piedra" and found in Colombia. Small sandlike masses are found along the shafts of the hairs.

*Morphology*.—The spores are arranged like mosaics about the hair and are 2 to 12 microns in diameter. The adult cells are 12 to 15 microns and polyhedric.



FIG. 10

*Epidermophyton cruris* (*In Tissues*)      Spindles (*In Culture*)

*Cultural*.—Growth occurs readily on various media. Cultures show the mycelial threads septated, cylindrical and 1 to 4 microns thick. Colonies are light brown in color.

*Monilia candida*.—This *hyphomycete*, described by Bonorden, is of practically no importance in medical consideration and has been very slightly investigated. It is found growing in decayed vegetable matter and is occasionally found parasitic as white or gray areas on the mucosa or tongue of man or other animals where it

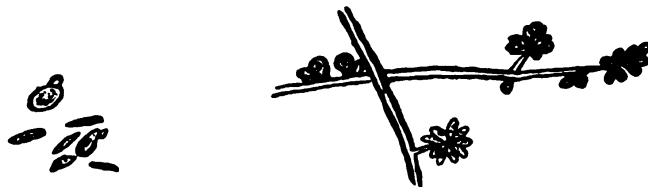


FIG. 11

(*In Tissue*)      *Beurmanni* (*Gougerot*)  
(*In Culture*)

resembles human thrush. It has been reported in children and adults and is also known as *Monilia bonordini*.

*Morphology*.—The simplest type of exospores, known as conidia, are present. They are smooth, round, and 7 to 8 microns in diameter. The mycelium is 1 to 2 microns thick, which is relatively thin for this genus of mold.

*Cultural*.—Gross and microscopic structure are in general those of the other monilias as recorded above. Culture and biochemical reactions are but fragmentary in the literature.

(To be continued)



## CLINICAL NOTES

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### GONOCOCCUS INFECTION OF THE HEART—WITH A REPORT OF TWO FATAL CASES DUE TO A GRAM NEGATIVE DIPLOCOCCUS

By J. M. McCANTS, Lieutenant Commander, Medical Corps, United States Navy

#### HISTORY

Among the first to recognize an endocarditis during the course of a gonorrhoeal infection and to suspect a causal relation of the two conditions were Ricord (21) in 1847 and Brandes (21) in 1854. Leyden (7), in 1893, demonstrated what was considered the gonococcus on the endocardium, but it was Hewes (21) who, in 1894, was first to isolate the gonococcus from the blood stream of a patient with gonorrhoeal arthritis. The next year Thayer and Blumer (21) cultivated the gonococcus from the blood of a patient suffering with acute endocarditis.

Since this early work many cases have been reported, and, in instances, gonococci have been demonstrated in the valves of the heart, in the vegetations, in the blood, have been cultivated, and have been successfully inoculated in man. Up to 1912 over 100 cases had been reported, the diagnosis not always being based upon laboratory procedures; for in only 12 of these cases had the organism been identified by cultural methods. Neither are we sure that the meningococcus was ruled out with certainty. At present gonococcus infection of the heart is being recognized in many countries, but text books on medicine barely mention this complication.

#### ETIOLOGY

The specific organism causing this type of heart disease is the gonococcus (*Neisseria gonorrhoeae*). The disease occurs in both sexes but is more common in males, and is found by far more frequently in young adults. This cardiac condition—an endocarditis, pericarditis, or both—is perhaps always a complication of a preceding or concurrent gonorrhoea and occurs most frequently about the fourth or fifth week of the initial infection, and often simultaneously with a gonorrhoeal arthritis.

When compared with other organisms the gonococcus is not a frequent cause of heart disease. In order of frequency Webster (21)

gives the following organisms as a cause of acute endocarditis: *Micrococcus rheumaticus*, so called, of Poynton and Paine; streptococci (*Streptococcus viridans* and less frequently *Streptococcus hemolyticus*); staphylococcus; pneumococcus; bacillus influenzae; the gonococcus; and the *Treponema pallidum*.

That the gonococcus is not a common cause of heart disease is further illustrated by the fact that Cabot (4) failed to find it in any case of his series of 1906 necropsies on cardiac cases. Of this series, 180 had endocarditis and 186 had pericarditis, apparently all due to other organisms than the gonococcus.

Such predisposing factors as traumatism, labor, unskillful instrumentation, alcoholic or sexual excesses, menstruation, pregnancy, and lowered resistance, due to diseases like tuberculosis and diabetes, are mentioned in the literature. Of these, traumatism (labor, instrumentation) and lowered resistance would seem important. A number of cases have been reported as beginning during the puerperium.

#### PATHOLOGY

The pathology in the heart is not characteristic of gonococcus infection, but in general the lesions are those of any acute, malignant endocarditis. The vegetations are luxuriant, soft, friable, and composed of fibrin infiltrated with leucocytes and gonococci. Varying degrees of erosion, ulceration, and valve destruction may be found. As is true of endocarditis in the adult in general, the lesions are usually confined to the left heart. The relative frequency in which the various valves are affected is given by Geiringer and Campuzano (21) as follows:

	Per cent
Mitral.....	48
Aortic.....	39
Pulmonary.....	5.3
Tricuspid.....	2.6

An acute pericarditis may accompany a gonococcus endocarditis in rare instances. Also, a gonococcus pericarditis as the only cardiac complication of a gonorrhoea is a rather rare condition. The amount of effusion is seldom great, but has been reported in sufficient quantity to cause cardiac embarrassment with marked relief on aspiration. The fluid may be serous, serofibrinous, purulent, or sanguinous.

In either endocarditis or pericarditis a simultaneous myocarditis may be assumed to exist. The gonococci may be found both intracellular and extracellular in direct smears made from the soft vegetations or in smears made from centrifugalized pericardial exudate, but cultures and agglutination tests are necessary to identify this organism with certainty. Both streptococci and staphylococci have been found associated with the gonococcus in the vegetations of an

occasional case. Likewise the streptococcus alone was considered the etiologic agent of endocarditis complicating a few cases of gonorrhoeal arthritis. An instance of "Infectious endocarditis of the aortic sigmoid valves with perforating aneurysm of a sinus of valsalva during the course of gonorrhoeal rheumatism" was reported by Mouisset and Chalier (15), and we are reporting a case of cardiac rupture in a case of apparent gonococcus pericarditis. Embolic metastasis may involve the liver, spleen, kidneys, etc., and the spleen and liver are frequently enlarged. Petechia may occur.

#### SYMPTOMATOLOGY

It is stated that, in general, the symptomatology of gonorrhoeal endocarditis is less acute than it is in other forms of ulcerative endocarditis. We have not found this to be true in the four cases, all fatal, which we have observed during the past 12 years. The picture is that usually seen in acute, malignant endocarditis in general, characterized by a septic type of temperature, chills, sweats, leucocytosis, loss of weight, and increasing pallor. The usual cardiac signs of an endocarditis or a pericarditis should be sought for and may sooner or later be found during the course of the disease. Petechia and other forms of septic emboli may occur. Enlargement of the liver and spleen is usual. The gradual development of physical signs is illustrated in the two cases presented.

#### DIAGNOSIS

If, during the course of a gonorrhoea, symptoms and signs of acute endocarditis or pericarditis occur, it is reasonable to suppose that the gonococcus is the etiologic agent. The etiology would be still more suspicious if the symptoms of an acute cardiac infection came on during the puerperium or during the presence of a gonorrhoeal arthritis. In acute endocarditis the etiologic organism can be determined by blood cultures only. These cultures should be repeatedly done. Should a gram negative diplococcus be isolated, it must be identified by cultural and serologic studies, the meningococcus being the most important organism likely to be confused with the gonococcus. In case repeated blood cultures remain sterile, this fact is in favor of the gonococcus, since, as is well known, the gonococcus is not easily cultivated. Repeated blood cultures should show the meningococcus, but even this organism is not grown as readily as many textbooks would lead one to believe, and is grown far less readily than other organisms which commonly cause endocarditis. Blood cultures should be repeatedly done on a given case, and incubation should be prolonged in this type of work, for organisms have a tendency to enter the blood stream by crops. Thus

a single blood culture may be negative by reason of not having been done at just the right time.

In pericarditis, on the other hand, there is the additional method of paracentesis pericardii with examination of the pericardial fluid. The X ray is of great value here.

It is well to bear in mind that to establish a diagnosis of acute endocarditis rules out acute pericarditis, and vice versa, for practical purposes; since it is rare for both conditions to exist in the same heart at the same time. Cardiac murmurs heard during the course of an acute pericarditis are of no value in establishing diagnoses of intracardiac lesions.

It is important for the clinician to make frequent examinations of the heart during the course of gonorrhoea, especially when symptoms of sepsis occur. Symptoms which should make us suspicious are easily attributed to some other complication such as arthritis. It is also known to be possible, though not common, for gonococcus infection of the heart to occur when the original focus of infection is apparently cured, quiescent, or forgotten.

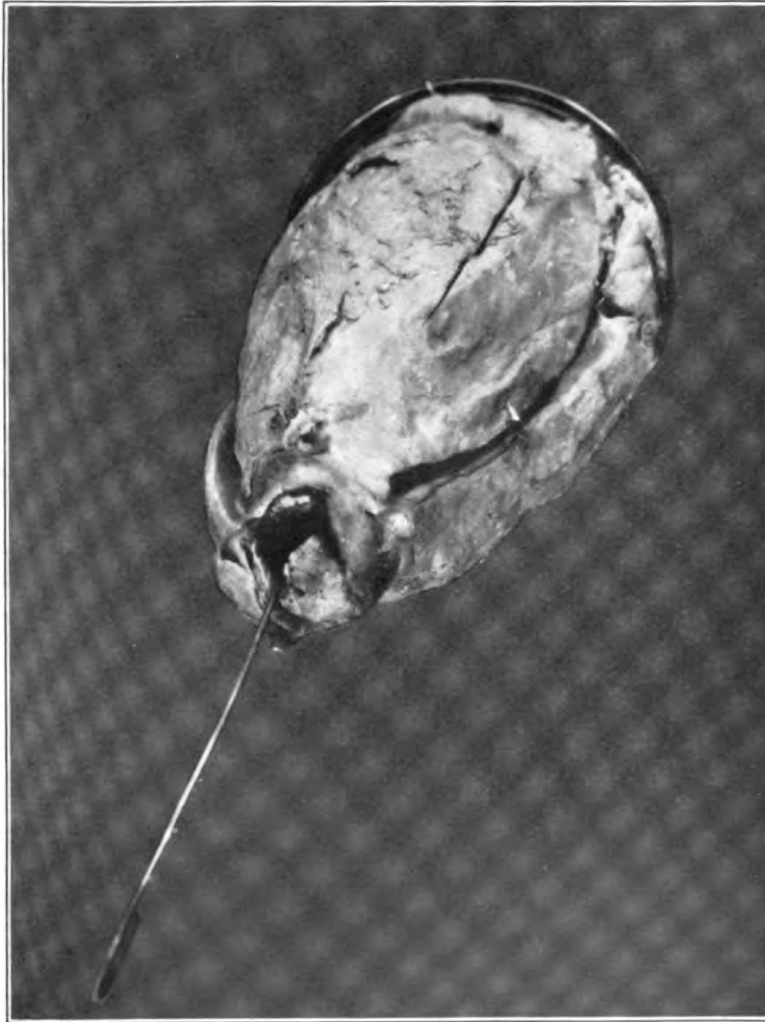
#### COMPLICATIONS

The complications of gonorrhoea are numerous. Gonococcus infection of the heart itself is merely one of these complications, perhaps the most important, but fortunately it is comparatively rare.

Gonococcus infection of the heart is the direct result of a gonococcus septicemia. Just how these organisms enter the circulation is not too well understood. Laforo (21) thinks that the gonococci gain access to the blood stream through the lymphatics, but in some instances the route is believed to be through the medium of a venous thrombus. The resistance of the individual, trauma; etc., as mentioned under etiology, are also thought to play a part. That there are secondary complications from a gonococcus endocarditis itself seems quite logical. Infarcts of the spleen, petechia, pleuritis, etc., may occur during the course of a gonococcus endocarditis and, we think, are more reasonably ascribed to the endocarditis itself than to the original focus of infection.

#### PROGNOSIS

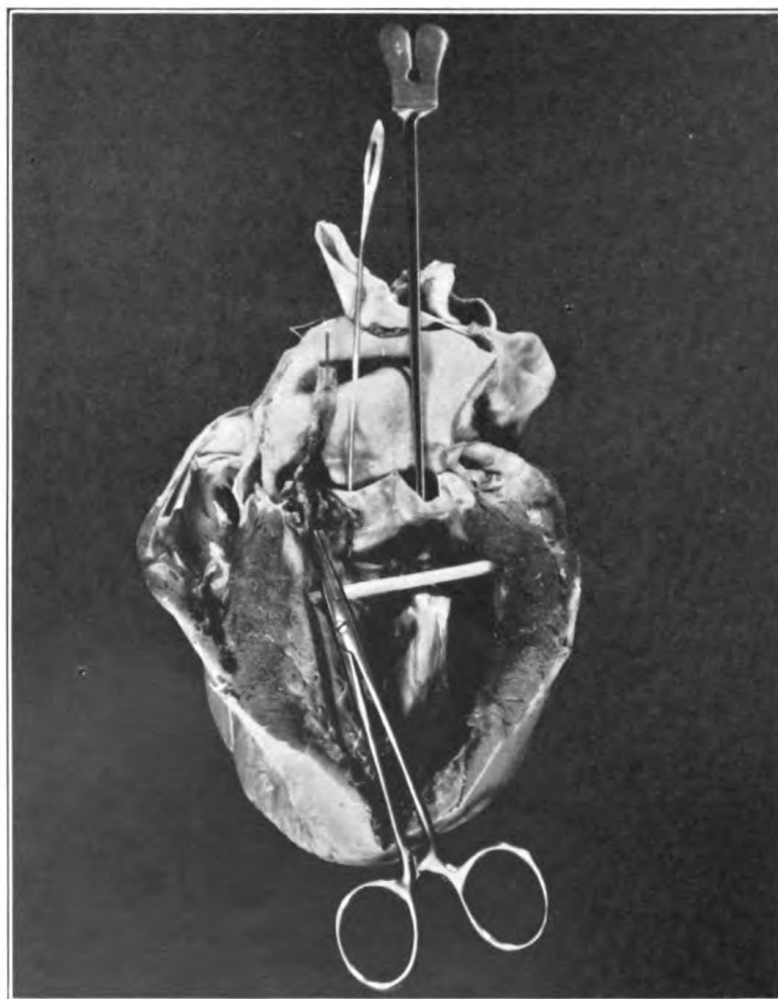
Gonococcus infection of the heart is a very fatal condition. The prognosis depends not only upon the gravity of the cardiac condition, but upon other complications liable to be present at the same time. The acuteness of the condition, whether or not there is time for the patient to develop antibodies, the virulence of the organism, the resistance of the host, as in other infections, play a rôle here. In the literature are mentioned mild cases in which spontaneous re-



HEART OF CASE NO. 1

Note the necrotic, somewhat elevated and doughnut shaped apex with probe passing through rupture into left ventricle. The original rupture was not as large as it appears here, owing to the heart having been incised with subsequent hardening and distortion. Anterior view with apex markedly elevated.

606-1



HEART OF CASE NO. 2 SHOWING THE LEFT VENTRICLE, AORTIC RING, AND ASCENDING AORTA SPREAD OPEN

The grooved director shows a normal aortic cusp, the probe passes through a perforated cusp, and the hemostat points to a luxuriant vegetation which has destroyed a cusp.

606 -2



coveries took place. The diagnosis in many of these patients who recovered was not established beyond question. A few recoveries in severe cases have been accredited to special forms of treatment.

#### TREATMENT

The treatment for the most part is symptomatic and that for acute endocarditis in general. Complete rest, internal and external hydrotherapy, an easily assimilable diet, and laxatives are essential. Codeine or morphine may be necessary for rest or to control pain. Alcohol is said to be contraindicated. Likewise digitalis should perhaps not be given except in frank decompensation of the heart, under which circumstance too much should not be expected of the drug. The original focus of infection and other complications should also be treated. Of special measures employed, we shall mention the following: One case of pericarditis was mentioned in the French literature as being markedly, though temporarily relieved by paracentesis pericardii. Aubertin and Gambillard (1) reported a case cured by the intravenous use of antigonococcus serum. This was accomplished after failure with gonococcus vaccine, uroformin, and electrargol. Rici (17) reported a case cured by the intravenous use of one per cent collargol, and also Widal (22) obtained similar results. Mouisset and Chalier (15) were not successful with collargol. Antigonococcus serum, 15 to 25 cubic centimeters every four hours, is recommended by Geiringer and Campuzano (21).

#### CASE REPORTS

CASE No. 1.—*L. S.*—Sea-2c, readmitted October 25, 1928.

Diagnosis: Catarrhal fever, acute.

Chief complaint: Weakness in legs.

F. H.: No bearing on present illness.

P. H.: Pertussis. No serious illness or injury. No operations. Denies all venereal diseases. Born and lived in Illinois until entry into service.

P. I.: Illness began four days ago while ashore in Los Angeles. While walking he suddenly noticed weakness of legs. No pain or dizziness, but felt hot. Continued to walk, however, and returned to his ship the same day. The next morning the weakness persisted and he reported to sick bay. Later he developed slight pain in left chest on deep breathing. At present he complains of slight headache, aching legs, and some pain in left ankle.

P. E.: A moderately well developed and nourished, white, single male, 18 years of age. Temperature 100.4° F., pulse 72, respiration 20 on day of admission. Patient has delayed cerebration and talks with a subdued speech. Marked increase of breath sounds in left upper third of chest with modified vocal fremitus in same area. There is an area of inflammation 3 to 4 centimeters in diameter over dorsum of left metatarsals. This area is tender and painful to pressure. No evidence of recent wound or skin infection. Examination otherwise negative.

*Treatment.*—General symptomatic, supportive, and local hot magnesium sulphate dressing to left ankle instituted.

October 27, 1928: Large inflamed area over dorsum of left foot persists and is very painful.

October 29, 1928: Redness less over dorsum of left foot. Temperature dropped to normal at noon for the first time. Pulse remains normal. Temperature range has been from 99.8° F. in morning to 102.4° F. in afternoon.

*Summary of laboratory data to date.*—Urinalysis, negative. Blood count, W. B. C. 9,650. Neutrophiles, 69 per cent; lymph, 22 per cent; monocytes, 7 per cent; eosinophiles, 2 per cent; mast cells, 2 per cent. Blood culture, negative after 96 hours incubation. Sputum, negative for acid fast bacilli. Kahn, negative. X ray of chest (portable) the right lung field is clear. The left lung field is not as clear as the right, and the markings along the first intercostal trunk are increased. Findings are not definite enough to warrant a diagnosis.

*Subsequent course, laboratory data, and treatment.*—October 30, 1928: Temperature 102° F., but reached normal once to-day. Foot improving. Septicemia or acute endocarditis suspected.

November 2, 1928: Temperature 102.8° F.; complaining of pain over lower left ribs anteriorly; no petechia; spleen not palpable. Aspirin grains 10 q. 4 hours continued.

November 5, 1928: Intermittent fever with moderate sweats. Temperature 104.6° F. Examination of heart, negative; blood culture, negative; W. B. C., 14,000; neutrophiles, 71 per cent; lymph., 28 per cent, transitionals, 1 per cent.

November 7, 1928: Temperature normal this p. m. Inflammation of foot has subsided. No pain or tenderness, but patient still looks sick.

November 9, 1928: Temperature 102° F. Severe pain in right shoulder and unable to move arm due to pain. Aspirin continued with occasional dose of codeine. W. B. C. 9,700 with 67 per cent neutrophiles yesterday. Urinalysis, negative. Blood culture, negative.

November 14, 1928: Severe pain in anterior left chest yesterday with cyanosis, rapid pulse, respiration 35-40. Severe sweat during night. Blood culture, negative. Eye, ear, nose, and throat examination, negative. W. B. C. 19,900 with 86 per cent neutrophiles. Sputum negative for acid fast bacilli. X ray chest (bedside), increased cardiac shadow which is very suggestive of pericarditis with effusion. The appearance of the right side of the heart, however, makes it necessary to think of a possibly dilated heart. No evidence of fluid is seen in either chest cavity.

November 15, 1928: General condition improved. Left chest very painful so that it is difficult to percuss heart.

November 16, 1928: Paracentesis pericardii. 500 cubic centimeters serosanguinous fluid removed which was followed by much improvement in his general condition. Right shoulder continues very painful.

*Examination of fluid.*—Amount, 500 cubic centimeters. Fluid is viscid and bloody. Smears show pus and red blood cells as well as Gram negative intra and extra cellular diplococci with morphology of the gonococcus. Cultures on agar, bouillon, and blood plates were negative. Inoculation of fluid into eye and peritoneal cavity of guinea pigs, negative. Tentative identification of organism is the gonococcus.

November 17, 1928: Condition certainly improved as compared with past 72 hours.

November 18, 1928: Paracentesis pericardii; 360 cubic centimeters of fluid removed with laboratory results similar to that reported above; 10 cubic centimeters 0.5 per cent mercurochrome left in pericardial sac; 15 cubic centimeters 0.5 per cent mercurochrome intravenously was followed by a moderate reaction.

No meningeal symptoms. Denies ever having had a urethral discharge. Prostatic examination revealed no pus, but prostate was slightly nodular.

November 20, 1928: Portable X ray shows effusion, and paracentesis was repeated; 300 cubic centimeters of a similar though more bloody fluid removed. Laboratory examination similar to that reported above, but organisms were far less numerous than before; 10 cubic centimeters 1 per cent mercurochrome left in pericardium. Mind clear. Sleeps well. Frequent marked perspiration.

November 21, 1928: 20 cubic centimeters 1 per cent mercurochrome given intravenously at 10 a. m., moderate reaction; appears stronger; voice improved. Read letters from relatives and dictated a reply to his mother. Later complained of pain in cardiac region.

About 9.05 p. m. patient suddenly collapsed and was dead at 9.12 p. m. An incomplete autopsy showed the pericardium to be thick and adherent to the left ventricle in lower half. Minor recent adhesion on right upper portion of sac. Balance of sac distended with blood and blood clots. Epicardium stained with mercurochrome. Apex showed an area of necrosis 1 by 2 centimeters with a rupture communicating with the left ventricle. Liver markedly enlarged and showed chronic passive congestion; weight, 2,900 grams. Spleen, 200 grams, soft, and showed area of infarction 2 by 3 centimeters. Kidneys hyperemic. Peritoneum and gastrointestinal tract negative. Lungs showed no gross pathology. Joints showed no gross pathology by external examination.

CASE No. 2.—J. C. G.—Seaman, first class, readmitted April 13, 1929.

Diagnosis undetermined (myocarditis, acute).

Chief complaint: Pain in joints.

F. H.: No bearing on present illness.

P. H.: Born in Maine. Enlisted 1927. Does not recall any illness. Denies rheumatism, sore throat, trouble with teeth, and venereal diseases.

P. I.: Six days ago patient developed a headache, chills, fever, and sweats, which have persisted till the present time. Four days ago both elbows became painful and later both knees and ankles. He now complains of pain in hands, knees, and ankles. Three days ago patient noticed small red areas on hands, arms, and legs. Marked weakness. No cough, sore throat, or cardiac symptoms.

P. E.: A well-developed and fairly well nourished, white, single male, 20 years of age. Appears to be acutely ill and very weak. Temperature 102.8° F., pulse 110, respiration 20 in afternoon of day of admission. There are numerous small red areas scattered over the face, arms, hands, legs, and feet. Some of the areas are hemorrhagic and others erythematous. Heavily infested with lice. Profuse sweating. Anterior pillars of fauces somewhat injected. Breath sounds are harsh over left base with scattered moist râles. Heart normal except for roughening of first sound at base. Tenderness of both wrists, elbows, knees, and ankles on palpation, but with no redness and practically no swelling. No other findings.

*Treatment.*—Treatment for pediculosis and for rheumatic fever instituted while further studies were being made.

April 14, 1929: Two chills followed by elevation of temperature.

April 16, 1929: Severe chill in morning. Temperature 105° F., pulse 160, respiration 28. Another chill in afternoon. Abdominal distension requiring an enema. The following laboratory work is summarized to date: Urinalysis, negative. Blood count (April 13, 1929), R. B. C. 4,210,000, hemoglobin, 80 per cent; W. B. C., 19,500; neutrophiles, 88 per cent; lymphocytes, 12 per cent. No malarial parasites. Blood culture, negative; Kahn, negative. Blood count (April 16, 1929), W. B. C., 30,050; neutrophiles, 88 per cent; lymphocytes, 9 per cent; monocytes, 2 per cent; eosinophiles, 1 per cent.

*Subsequent course, treatment, and laboratory data.*—April 17, 1929: Intravenous mercurochrome instituted. Blood culture negative. Systolic murmur at base transmitted into vessels of neck.

April 23, 1929: Chills, fever, sweats, leucocytosis, and septic type of temperature continue along with increasing pallor. A definite aortic insufficiency now exists with double murmur heard best in third interspace just to left of the sternum, Corrigan's pulse, Duroziez's sign, and a blood pressure of 130 systolic and 40 diastolic. Systolic thrill at base of heart. W. B. C. 28,550 with 81 per cent neutrophiles. General symptomatic, supportive, and intravenous mercurochrome treatment continued. Urinalysis negative, except for trace of albumin. Throat smears and cultures negative for *B. diphtheriae*. Vincent's organisms, and streptococci. Blood culture negative. Diagnosis changed to endocarditis, acute. Fecal cultures negative for typhoid-dysentery group of organisms.

April 24, 1929: X-ray of chest (bedside). Fails to show lung pathology. Cardiac shadow is suggestive of a beginning pericarditis with effusion.

April 28, 1929: Failing heart. General condition otherwise about the same. Morphine as necessary for pain and restlessness. Glucose proctoclysis. R. B. C. 2,910,000. Hemoglobin 60 per cent. Type O blood (international classification).

May 1, 1929: Blood transfusion. 175 cubic centimeters whole blood given by direct method.

May 4, 1929: Blood transfusion. 250 cubic centimeters blood given by citrate method. Condition still grave with little change.

May 8, 1929: Blood culture negative.

May 10, 1929: Temperature 100 to 104.4° F., pulse 100 to 140, respiration 20 to 32. Blood transfusion by citrate method.

May 12, 1929: Became progressively weaker and died at 2 p. m.

#### AUTOPSY REPORT

(a) *General.*—Time of death, 2 p. m. May 12, 1929. Time of autopsy, 9.15 a. m. May 13, 1929. Body pale, cold, with evidence of recent loss of weight. Rigor mortis.

(b) *Thorax.*—About 300 cubic centimeters clear transudate in each pleural cavity. Lungs show petechial hemorrhages over pleural surfaces. On section lungs are congested and edematous with hypostatic congestion at bases. Frothy fluid exudes from cut surfaces. A few cubic centimeters of purulent exudate in pericardium. Smear shows pus cells but no organisms. The heart is pale and flabby. There is a large vegetation which has destroyed one of the aortic cusps, and one cusp has been ulcerated through at its base. No vegetations on mitral or other valves. There is a blood clot adherent to mitral valve, and a large antemortem clot in right auricle extending into the vena cava. Smear from above vegetation shows fibrin, pus cells, and numerous intra and extracellular Gram negative diplococci with morphology of the gonococcus.

(c) *Abdomen.*—Liver, kidneys, and spleen show evidence of passive congestion. The spleen is very large, friable, markedly congested, and shows one small healed infarct. The prostate is small and nodular.

(d) *Diagnosis and cause of death.*—(1) Primary, acute endocarditis; (2) secondary, (a) acute pericarditis, (b) pulmonary edema.

## COMMENT

Case No. 1 is interesting in several ways. The X ray, made upon suspicion of pericarditis, aided materially in deciding to aspirate. The aspiration revealed an organism not thought of as a possibility at first. The fact that laboratory evidence was in favor of the gonococcus led to the use of mercurochrome intrapericardially and intravenously. We thought we had reason to hope that this patient would recover, until death came on suddenly due to cardiac rupture. The punctures had been made in the left xyphochondral angle; so that the needle did not approach the site of subsequent rupture.

We have been informed by the consulting service of a system of medicine that they have been unable to find another similar case on record where the diagnosis had been made by paracentesis pericardii or where local treatment had been used. One case of gonococcus pericarditis had been reported in which temporary relief was afforded by paracentesis pericardii, but the diagnosis was not made by examination of the fluid, and no therapeutic agent was introduced into the pericardium.

CASE No. 2.—The etiology of this condition was not suspected until autopsy. The diagnosis of acute endocarditis was made, however, and the gradual development of physical signs in this case was classical.

The question of etiology is still somewhat debatable in both of these cases. The denial of gonorrhoea by both of these patients would seem to be of considerable significance, but people in the naval service often apparently think that they have reason to deny venereal disease until it is demonstrated. The denial, however, in these two cases was substantiated by essentially negative clinical evidence of gonorrhoea. It must still be remembered, however, that gonococcus infection of the heart can and does occur after the primary infection has subsided.

The fact that blood cultures were repeatedly sterile lends weight to the gonococcus. Also the repeatedly negative cultures made from the pericardial fluid in which gram negative diplococci of typical morphology were demonstrated, together with negative results on guinea-pig inoculations, would favor the gonococcus. Guinea pigs are not always susceptible to the meningococcus, but much more so than to the gonococcus.

It is also well known that in meningitis due to the meningococcus certain complications as arthritis, epididymitis, otitis media, and endocarditis may occur due to the meningococcus. But neither of these cases had clinical evidence of meningitis. That a meningococcal septicemia with arthritis, endocarditis, etc., but without meningitis may occur is now being realized. The diagnosis as to etiology in both of these cases is uncertain, but we are in favor of the gonococcus.

To make repeated blood cultures, to use every means to establish a diagnosis in these cases, and especially to recognize the meningococcus early would seem important; for upon the diagnosis proper therapeutic measures will depend.

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**IMPLANTATION OF CARCINOMA CELLS ON THE ENDOCARDIUM OF THE  
RIGHT AURICLE**

**REPORT OF CASE<sup>1</sup>**

By H. E. RAGLE, Lieutenant Commander, Medical Corps, United States Navy

Malignant tumors of the heart are rare and seldom produce symptoms which lead to a diagnosis before coming to the necropsy table.

Adami states: "The heart, above all organs, is constantly in a state of great efficiency, well innervated, and functionally always active, so that it is less likely to take on aberrant growth."

Primary tumors of the heart are very rare. Nearly all forms of mesoblastic tumors have been found. Some authorities deny the possibility of primary carcinoma, although Lindsay (2) reports a case. Other cases have been reported, but were not confirmed by microscopic section. Gummata are not so uncommon.

Secondary cardiac tumors are more common, although they are still rare enough to be of interest. A review of 37,000 autopsies shows 110 cases in which carcinomata predominate. The majority have been found in cases of general carcinomatosis and in those of direct extension into the pericardium and the heart muscle. Relatively few have been reported by implantation of carcinoma cells on the endocardium. The case reported below is one of implantation of carcinoma cells on the endocardium of the auricular appendix of the right auricle. The primary tumor was in the right lung and the secondary in the right auricle; therefore the mode of metastasis was by the systemic rather than the pulmonary circulation.

**BRIEF ABSTRACT OF HISTORY**

Machinist's mate, second class, white; age 39; past history and family history of no bearing.

*January, 1928.*—Onset with a pleuritic pain in the right chest. Clear straw-colored fluid was aspirated from the right pleural cavity.

*April, 1928.*—Rib resected. Purulent fluid drained. Drainage continued for several months.

*January, 1929.*—The practically closed previous resection was reopened. X-ray findings at this time showed fluid in the right pleural cavity to the level of the seventh rib.

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<sup>1</sup> From the laboratory service of the U. S. naval hospital, Mare Island, Calif.

At operation a piece of firm white tissue was removed from beneath the pleura. Histopathological examination showed it to be an epidermoid carcinoma of the lung. There were no cardiac signs or symptoms.

There was considerable drainage, but the opacity by X-ray and the dullness by percussion did not diminish. The shadow and dullness progressively increased and the patient's condition gradually declined.

June 10, 1929.—Died.

#### NECROPSY REPORT

The body of a well-developed emaciated white male about 39 years of age. Teeth in fair condition. Pupils equal and slightly contracted.

There is an operative wound in the right lower chest (rib resection) from which there is a thin, foul-smelling discharge.

*Chest.*—The pericardium is normal. The heart is normal in size, musculature is soft and flabby. The valves are normal. Projecting into the auricular appendix of the right auricle is a firm white mass measuring 3 by 2 by 1 cm. which is loosely attached to the endocardium. The remainder of the heart showed no evidence of tumor metastasis. The coronary arteries and aorta are normal.

*Lungs.*—The left lung is normal except for some hypostatic congestion in the dependent portions.

The right lung is firmly bound in the pleural cavity. The lateral portion, for the thickness of 5 cm., is a solid white tumor mass which extends into the intercostal spaces. The inferior part is similar in nature and extends through the diaphragm and into the liver for a distance of 3 cm. The right mediastinal glands are greatly enlarged, firm and white. The greater portion of the right lung is gangrenous.

*Abdomen.*—The stomach and intestines are normal. The spleen is enlarged and quite soft, and there is a subdiaphragmatic splenic abscess containing 150 c. c. of pus. The pancreas is normal.

The liver is invaded by a tumor mass extending from the right lung through the diaphragm. The mass measures 3 by 5 by 5 cm. The remaining part of the liver is normal. The gall bladder is normal.

The kidneys are swollen and the cut surfaces show a marked passive congestion. The capsules strip easily. The urinary bladder and prostate are normal. There are no enlarged retroperitoneal or mesenteric lymph glands.

#### GROSS DIAGNOSIS

1. Carcinoma of the right lung.
2. Myocarditis chronic.
3. Carcinoma, metastatic, right auricle of the heart.
4. Carcinoma invading the liver through the diaphragm.
5. Nephritis acute.
6. Abscess of the spleen.
7. Gangrene of the right lung.

Histopathological section of the tumor mass in the right auricle shows it to be a squamous cell carcinoma with some areas showing a tendency to keratinization. See figures 1, 2, 3. Sections from the other tumor masses show the same pathology.

#### CONCLUSIONS

1. A case of secondary carcinoma of the heart by implantation is reported.



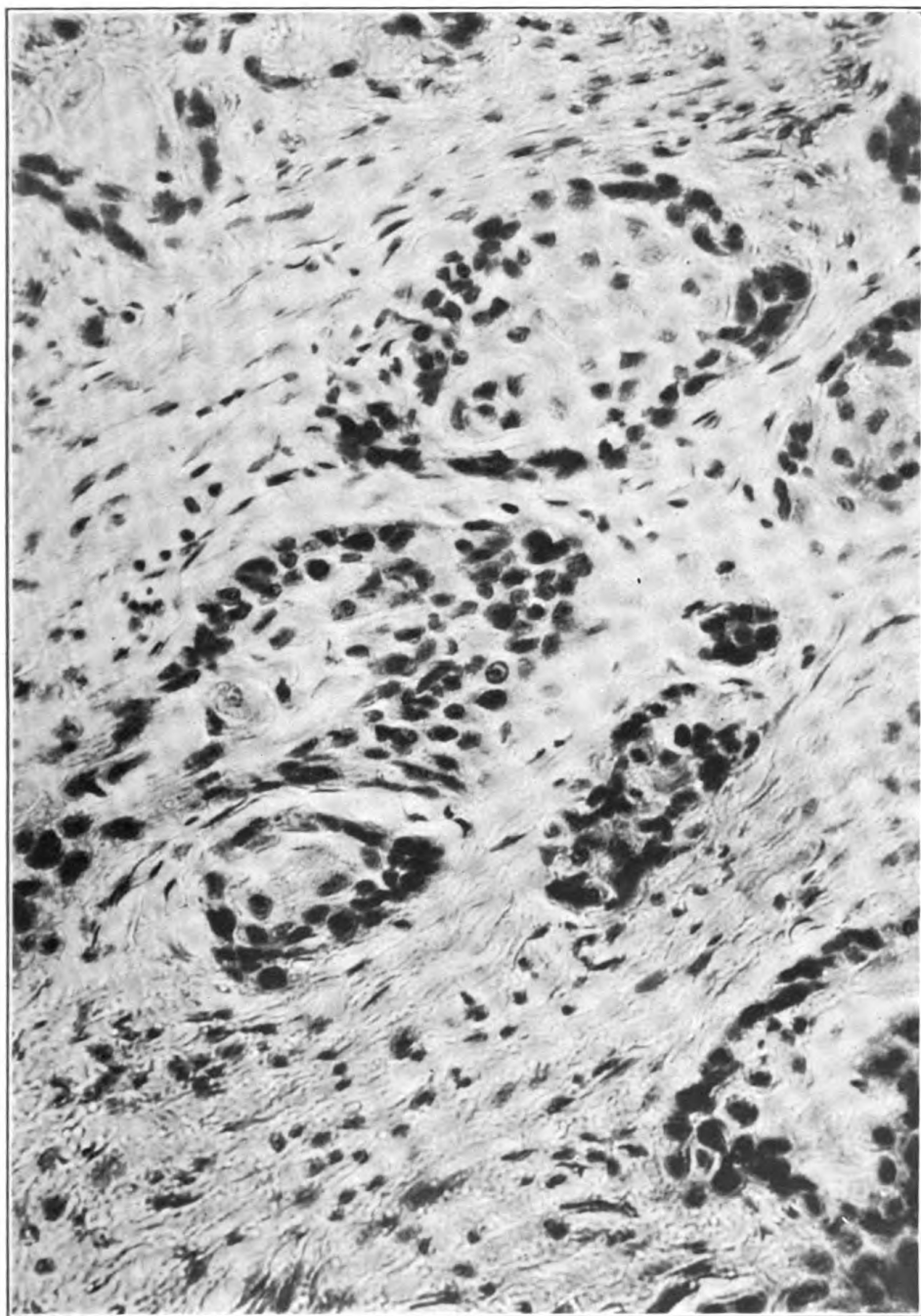


FIGURE I.—SQUAMOUS CELL CARCINOMA FROM THE ENDOCARDIUM OF THE  
RIGHT AURICLE. MAG. 300

614-1

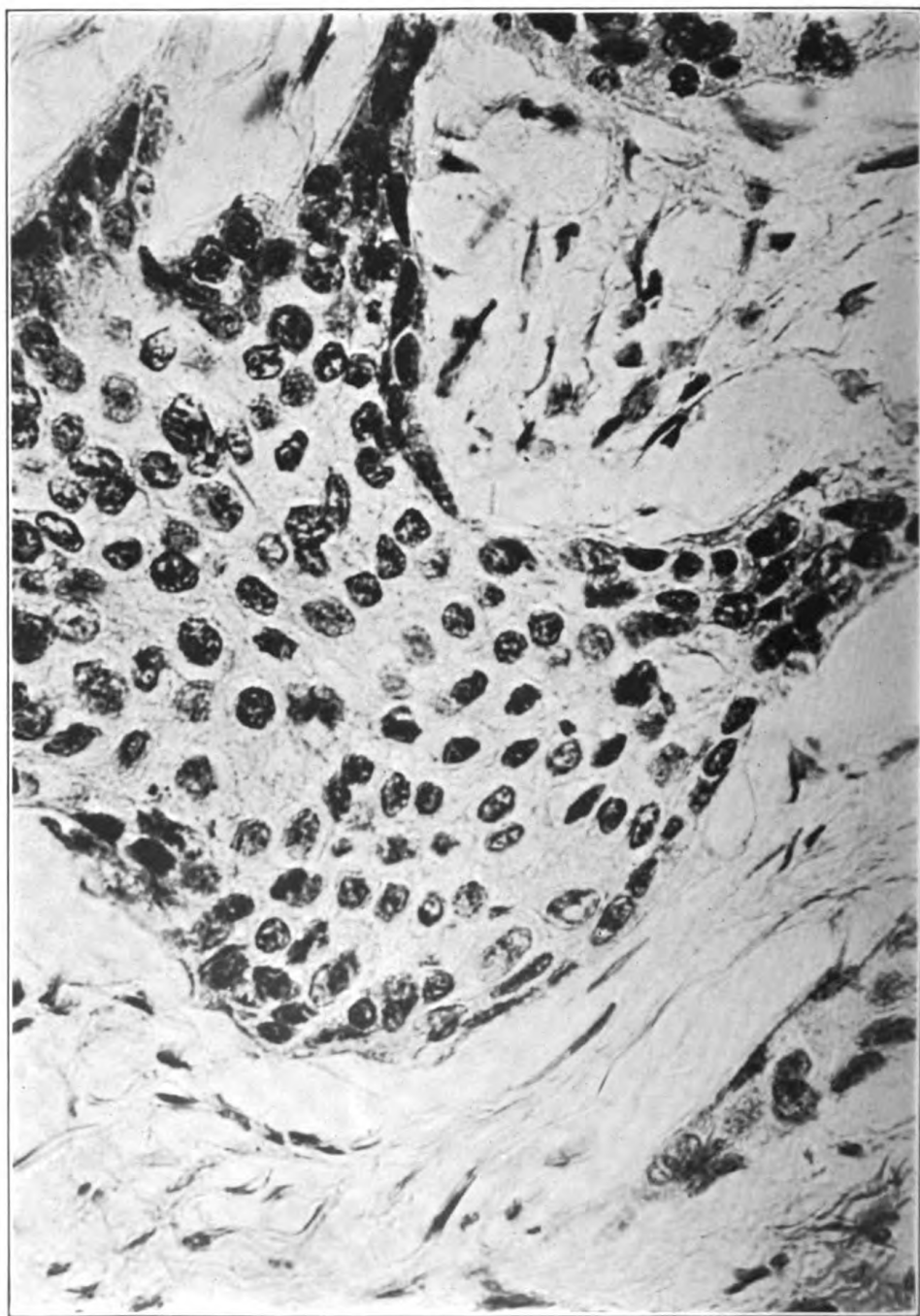


FIGURE II.—FROM FIGURE I. MAG. 630

614-2



614-3

FIGURE III.—FROM FIGURE I. MAG. 1,300



2. The carcinoma cells were carried by the systemic circulation and not by the pulmonary circulation.
3. There was no metastasis in any other part of the body.
4. The origin of the primary tumor was from the bronchial epithelium.

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**A CASE OF MENINGO-ENCEPHALITIS DUE TO TORULA<sup>1</sup>**

By E. C. WHITE, Captain, Medical Corps, United States Navy

Invasion of the cerebrospinal axis by wild yeast, *Torula histolytica*, is of sufficient rarity to warrant the reporting of all cases. The infection was first described by Stoddard and Cutler in 1916. In 1928 Wortes and Wightman could find reports of only 23 cases of torula infection in man, 19 of which involved the central nervous system, with fatal termination.

More cases have been reported from the San Joaquin Valley in California than from any other one section. This is the second case to be reported from this hospital, the first having been reported by Miller in 1925.

*Torula* is a wild yeast and occurs abundantly in nature on trees, fruits, and insects. It varies in diameter from 1 to 13 microns, is spherical or oval in shape, reproduces only by budding, and never produces mycelia or endospores. It does not ferment sugars. It is more pathogenic for man than are true yeasts. It never produces

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<sup>1</sup> From the U. S. naval hospital, San Diego, Calif.

skin lesions and has a predilection for the central nervous system and lungs.

The mode of invasion is uncertain, but is probably by way of the respiratory system, as the infection is usually found in the lungs. Spread of infection in the brain probably takes place along the perivascular spaces.

The clinical history is usually of a meningitis with subacute inflammatory reaction of the brain. The possibility of brain neoplasm, epidemic encephalitis, meningitis, etc., must be considered. Severe headache is a prominent symptom in all cases reported. Fever is absent or of low degree, leukocytosis is absent in the early stages and moderate in the later. Failure of vision, pain in and over the eyes, nausea, and vomiting are characteristic symptoms. The course of the disease is slow, usually several months elapsing before the inevitable termination in death.

Diagnosis during life can be made only by finding the characteristic torula in cytologic and cultural studies of the spinal fluid. After death they may be found in the tissues of the brain and lungs, and occasionally in other organs.

Treatment has been unsatisfactory. Repeated drainage of the spinal canal, washing the canal with saline solution, and even the irrigation of the canal with 1 to 1,000 mercurochrome have been tried, but with uniformly fatal results.

An interesting feature of the case reported is the fact that the patient was admitted to this hospital because of a skin disease and remained here six months immediately prior to the development of the disease, and therefore must have acquired it in this immediate vicinity. The course of the disease was two months.

#### CASE REPORT

E. R. W., sergeant, United States Marine Corps; age 24; was admitted to the hospital on April 11, 1929, as with psoriasis, having been surveyed home from China. His face and hands, in particular, were covered with sharply defined red patches with abundant silvery scales, though the eruption was more or less general.

He had contracted syphilis in Haiti in 1926 and during the next three years had received 23 injections of salvarsan, besides mercury and iodides. After nearly every injection his urine had contained albumin. In spite of energetic, though intermittent, treatment his Kahn test had remained positive until recently. The skin eruption began in October, 1928, about two years after commencing antiluetic treatment. It appeared on the back, hands, and face, in that order. He lost his finger and toenails and much of the hair on his head, axillae, and pubes. At the same time his weight increased rapidly from 160 to 190 pounds. He was sent from China to Canacao, P. I., and thence to San Diego, Calif. When admitted to San Diego Hospital the eruption was quite general and consisted of scaly patches which did not itch, were not elevated, and were not sharply circumscribed. It was considered to be dermatitis ex-

foliativa, due to salvarsan, and he was treated with sodium hyposulphite and emollient ointments. The progress of the disease was not satisfactory. Six weeks after his admission it was noted that his nails were again involved and loosening. At this time the possibility of a fungus infection was seriously considered and scrapings were made and examined, with negative results. In spite of the negative results he was put on fungicidal treatment and his skin was nearly clear at the time of the onset of the meningo-encephalitis. This is of some interest in view of the history, though invasion of the skin by *Torula histolytica* has never been reported.

*Present illness.*—On October 29, six months after admission to the hospital, he complained of headache. After a few days the headache became constant and so severe as to prevent sleep. Opiates were necessary to relieve the pain. He was almost constantly nauseated, and later vomited several times every day. Extreme muscular weakness developed.

On November 14 the spinal fluid was found to be under pressure of 40 mm. Hg., with nine cells, positive globulin, and Kahn 2 plus. At this time his sinuses and eyegrounds were examined and found to be negative. Headache in the occipital region increased in severity. In addition, he developed a persistent pain in both eyeballs. He was constantly nauseated and vomited at times. Increasing doses of morphine were required to give him even the smallest degree of relief. He became progressively weaker, and his vision began to fail rapidly. He became mentally dull, and complained of pain in the roots of the upper molars, the pain radiating into the head. His eyeballs protruded to some extent, and his pupils were dilated and equal. He complained of dizziness and ringing in the ears. By the middle of December he was completely blind. The general weakness progressed; he was constantly nauseated and vomiting, and complained of occipital headache when not under the influence of morphine. He died on December 24, two months after the onset of the disease.

*Laboratory.*—Two weeks before death his red blood count was 5,000,000; WBC, 13,000; polys, 82 per cent; lymphocytes, 16 per cent; no eosinophiles; hemoglobin, 95 per cent. Blood urea was 23 mgm.; creatinine, 0.9; uric acid, 1.1; calcium, 8.1 mgm.

On December 7 the spinal fluid was reported to be under pressure. It contained 267 cells, with a preponderance of polys. It was positive for globulin, negative for sugar, and there was no growth on the culture.

On December 24 the spinal fluid contained 259 cells. Besides the usual white blood cells there were many cells whose unusual appearance puzzled the technician who first examined the slide. Admiral E. R. Stitt, Medical Corps, was asked to examine it, and he identified the cells as torula bodies.

*Autopsy.*—At autopsy all organs were found to be practically normal except the lungs, brain, and spinal cord. Each lung had at its base a small well-encapsulated nodule about 0.75 cm. in diameter. The brain and cord were soft, with moderate congestion and plastic exudate under the pia and arachnoid. Microscopic sections of brain tissue and of lungs showed the presence of *torula histolytica* in abundance.

Sections of brain, liver, spleen, and lungs were sent to the Naval Medical School, and we are indebted to Lieut. Commander O. Wildman (MC), United States Navy, for the following report:

*Gross examination.*—Specimen consists of blocks of tissues including cerebrum, pineal body, lungs, liver, and spleen. Lung contains a white nodule 0.7 cm. in diameter.

*Microscopical examination.*—Lung section contains a necrotic area surrounded by a chronic inflammatory reaction with lymphocytic and plasma cell infiltra-

tion. This area contains great numbers of round or oval bodies with double contoured eosin staining wall and irregular dark staining inner mass. The size varies from small forms 3 or 4 microns in diameter to large round deeply staining ones of 15 to 20 microns. Many of the larger forms and some of the smaller ones show distinct budding.

**Cerebrum:** The pia is thickened and infiltrated with lymphocytes. Fairly numerous yeast cells of the same type as those in the lung are scattered through the tissue. The cortex of the cerebrum contains numerous rather large areas of necrosis or solution of the brain tissue without inflammatory cellular infiltration. These areas contain numerous yeast bodies, many of which are degenerated.

**Pineal body:** There is rather marked granular and fatty degeneration of the polygonal cells in the region of the central veins. No yeast cells are noted.

**Spleen:** Reticulo-endothelial cells contain much brown pigment. An occasional isolated yeast cell is seen, apparently causing no injury. Judging from the lack of pus cell reaction and the presence of the noninflammatory liquefaction of brain tissue this is probably torula infection rather than blastomycosis.

**Pathological diagnosis.**—Torula infection, lung, brain, and meninges; central necrosis, liver.

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#### PSEUDOMYXOMA PERITONEI

By H. V. HUGHENS, Lieutenant Commander, Medical Corps, United States Navy

Werth, in 1884, gave the first clear description of a clinical entity, which he called pseudomyxoma peritonei. He defined it as "a change in the peritoneum which is a complication of ovarian cysts." It is caused by a peculiar reaction of the peritoneum to the jellylike material which has escaped into the peritoneal cavity by way of spontaneous perforation of ovarian cysts.

After Werth's first description, numerous cases were reported, mostly by gynecologists, who observed pseudomyxoma peritonei in connection with ruptured ovarian cysts. But in 1901 Frankel first described the same condition in a man and demonstrated the origin of the gelatinous masses from the ruptured appendix. The same finding in women is recorded by Honecker, who reports an early stage of pseudomyxoma peritonei in a woman of 50 years who had normal ovaries. Michaelson reports gelatinous material in the abdomen surrounding and escaping from a perforation in the appendix with the adnexa normal. Cramer reports a woman of 50 with the abdomen full of jelly and both ovaries quite normal.



A most remarkable case is reported recently by Lauche and later by Schildhaus, who found pseudomyxoma peritonei in a man, starting from cysts originating in an umbilical tumor of the omphalomesenteric duct.

Up to the present date the literature contains reports of only six cases of pseudomyxoma peritonei in men. Michaelson (2) has reported three cases. He discusses the gross and microscopical pathology in detail. Southey and Webster (3) report one case with clinical history and detailed pathological report. Cleveland and Sleeman (4) report two cases with their operative and autopsy findings.

#### CASE REPORT

The writer's case was in a white male, aged 60 years, admitted to St. Vincents Infirmary February 27, 1928, with a history that indicated a ruptured appendix 32 years ago. Surgical drainage was done. Nine years ago he was taken with acute pain in appendiceal region and was operated on. Patient could not state what was found, but thinks that his appendix was removed at this time. In early 1926 his abdomen became uncomfortably large, causing some digestive and cardiac disturbances. Patient states that size of abdomen had gradually increased for past three years. A laparotomy was done by a Chicago surgeon. At this time a diagnosis of pseudomyxoma peritonei was made. The mucinous material was removed and usual closure of the abdomen was done. At 4-month intervals this process was repeated during the following year.

The physical examination shows a man 60 years of age, 64 inches tall, weighing 154 pounds. General appearance suggests ascites and cardiac distress. Chief complaint, distended abdomen, vertigo, weakness, and dyspnea. The physical examination was negative except for the above findings. Laboratory findings, 3,000,000 erythrocytes, 6,750 leukocytes, 79 per cent polys, 20 per cent small, 1 per cent large; N. P. N. 35, glucose 98, Wassermann negative.

Gastrointestinal series showed a diffuse tumor mass extending in and around the abdominal viscera. Otherwise negative.

Laparotomy done March 1, 1928, under ethylene and ether anesthesia. The following were the gross findings:

A tumor was found filling the entire left abdomen. This tumor had a more or less definite capsule which was adhered to the peritoneum anteriorly and to the cecum, ascending and transverse colon. Some of the ileum passed through the tumorous mass. Anteriorly there was a mass 30 cm. by 15 cm. by 2.5 cm., forming that portion of the sac. This tumor appeared to be composed of fatty and fibrinous material suggestive of carcinoma. The intestines formed the inner wall of the sac. The anterior left wall of the sac was composed of fairly thick fibrinous tissue. The sac was horn-shaped with the pointed end extending posteriorly behind the intestines to the region of the vertebra and the large end spilling over anteriorly about the median line.

The sac contained 8 liters of gelatinous, reddish-colored material, which was removed. This material was diffuse throughout the coils of the intestines involved, being encysted by omental adhesions. Another tumor was found in the upper right quadrant, containing 4 liters of similar material. This material was entirely encapsulated and was adhered to the liver and to the peritoneum posteriorly. This tumor was also horn-shaped, the tip of the horn pointing to the same region as the first. The spleen was palpated and found

to be apparently normal. The appendix had been removed. All the tumor mass and gelatinous material possible was removed. The two sacs were marsupialized and plain rubber drains inserted in each.

The reason for instituting drainage was the fact that patient had five times been operated for this condition, and it was the only course open that would prevent a repetition of these experiences.

*Pathological report.*—Macroscopical examination: Large tumor 20 by 9 cm., soft, fairly well encapsulated. Multilocular cysts are filled with mucinous material. There are also about 3 gallons of pseudomucinous material. Microscopical examination: Section from the cyst shows the walls of the small cysts to be made up of fibrinous and fatty tissue with an occasional area of round-cell infiltration. No epithelial cells could be found. Test showed gelatinous material to be pseudomucin.

*Clinical course.*—There was profuse cherry-colored drainage from the marsupialized sacs. Red blood cell count dropped to 2,275,000; leukocytes, 10,000; color index, 1; hemoglobin, 48. The color of mucinous drainage changed to white, denoting a cessation of the capillary oozing. On March 16 and 18, 250 c. c. of citrated blood was transfused, and 300 c. c. on March 28. On March 31, April 3 and 6, 250 c. c. of citrated blood was transfused. On April 15, red blood count was 3,375,000; leukocytes 7,100; color index, 0.85; hemoglobin, 60. Blood chemistry remained practically unchanged.

Due to the low resistance of cells secreting the pseudomucin it was decided to use deep X-ray therapy in an effort to destroy the cells. This was given for 15 minutes at a time, as often as the patient's condition would permit. Five treatments were given between March 8 and 14, when patient's condition contraindicated further treatment for a time. Following the improvement incident to the blood transfusion, on April 4 deep X-ray therapy was again begun. Six of 15, one of 20, and one of 30 minutes' duration were given between April 4 and May 1. The abdomen became almost normal in size, though a mass could still be felt in the lower left quadrant. The blood picture did not change during this course of X-ray therapy.

On May 3, two months after operation, the patient began to complain of severe pain in lower left quadrant. On May 4 pain became less acute and fecal material began to pass through the abdominal opening. Perforation in region of sigmoid suspected. Further surgery was contraindicated. Patient grew weaker until he died on May 14, 1928.

#### SUMMARY

1. Twenty-three years following the probable rupture of cystic appendix the first symptoms of pseudomyxoma peritonei occurred.
2. The condition progressed slowly for the next eight years, when the involvement became so extensive that frequent surgical drainage was necessary.
3. The two well-defined sacs found seem to be the first to be reported in cases of pseudomyxoma peritonei.
4. The enormous amount of pseudomucin is unusual.
5. The cherry color of the material always described in these cases is due to capillary oozing.
6. The secretion of the pseudomucin was greatly decreased and absorption stimulated by deep X-ray therapy.

7. It is thought that the perforation of the colon was due to cicatricial formation, which gradually cut off the blood supply to that area. Autopsy was not permitted.

8. This is the seventh case of pseudomyxoma peritonei to be reported in the male.

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3. Southey, M. V., and Webster, R.; pseudomyxoma peritonei. *The Medical Journal of Australia*, 1: 703-704, June 19, 1923.
4. Cleveland, J. B., and Sleeman, J. G.; pseudomyxoma peritonei of appendiceal origin and mucocele of the appendix. *The Medical Journal of Australia*, 1: 721, May 14, 1927.

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#### THE SYPHILIS PROBLEM ON A CRUISING SHIP

By L. G. JORDAN, Lieutenant Commander, Medical Corps, United States Navy

This article deals with the leuitic problem encountered on a newly commissioned ship, the U. S. S. *Lexington*, and presents some of the methods adopted to meet the situation as it existed during 1928 and 1929.

The average complement was 1,500 men. During periods of aviation activity the squadron personnel came aboard and increased this to about 2,000 men. Liberty was the same as for other ships of the battle fleet.

The men were informed by lectures and pamphlets on the subject of prophylaxis. The prophylactic station on board never closed, and sanitubes could be had for the asking.

The health records of the entire crew were scrutinized. The information on each syphilitic abstract found was copied on a separate paper for each man, the lower portion of the page being reserved for the record of treatments and diagnostic procedures performed on board. These sheets were then bound loosely and indexed.

Treatment lists were prepared and kept current, names being added as necessary to keep the total at a fixed figure. They were distributed each Friday to all divisions having men concerned. Treatments were given on Monday and Tuesday mornings.

A treatment record book was started and kept posted by a corps man. Upon the termination of each course of treatment, either by completion or due to transfer of the man, the data were transcribed upon the individual record sheet. Laboratory findings were entered immediately into the health record and the individual record sheet. It was necessary for the medical officer to check the paper work about every other week to insure maintenance of the proper routine.

The health records of all personnel reporting aboard were examined and all leucities taken up on the new record system. Current infections were added as diagnosed. During January, 1929, all health records were again searched and a list prepared of those who at any time had had diagnoses of chancroid but not of syphilis. Each of these men received a blood test. These procedures are now routine practice on the *Lexington*.

Analysis of the records showed that approximately 10 per cent of the crew had the diagnosis established, and of those diagnosed about one-half were in an active phase as demonstrated by clinical phenomena or by positively reacting blood.

In 18 months during 1928 and 1929, 65 new infections were diagnosed on board, or 20 per cent of the total from all sources. Four of these cases had extragenital lesions. One was an anal chancre. Another was a chancre of the lip in a wardroom mess attendant. The third and fourth were on the tonsil. One of the tonsillar cases was in a bugler who frequently exchanged instruments with a man who had concealed an active infection for some months.

Studying the incidence of these cases with respect to the location of the ship and the liberty conditions, it was noted that the usual rate was exceeded when overnight liberty prevailed.

All men reporting with penile or other suspicious lesions received at least three dark field examinations. If there was a history of self-administered local treatment, saline dressings were applied for several days prior to making the tests. Three positive dark field findings were considered sufficient evidence to establish the diagnosis. A Kahn test was usually done at this time for record.

Lesions which were negative for spirochetes, in the absence of other clinical evidence of lues, were regarded as chancroidal. Each case diagnosed as chancroid received a Kahn blood test 1, 2, 3, and 6 months after admission. The importance of this follow-up was amply attested by the fact that approximately 32 per cent of the diagnoses of syphilis established during the period of this report were the result of this procedure. In no case of this group were any secondary manifestations noted by the patient.

Concerning the 65 cases diagnosed aboard ship, the following data are of interest:

A. Positive dark field and negative Kahn.....	10
N. B.—Of these, six men subsequently developed strongly positive Kahn blood tests while under treatment. The other four remained negative throughout the period of this report.	
B. Positive dark field and positive Kahn.....	15
C. Healed or persistent initial lesion. Secondary manifestations, positive Kahn. Dark field examinations negative or had not been done, patient not reporting previously.....	17

## D. Originally diagnosed chancroid.

No history of secondary manifestations.

Dark fields negative.

"Follow-up" Kahn blood test positive..... 17

## E. Old chancroidal diagnoses made elsewhere.

Kahn blood tests positive ..... 4

## F. Kahn test done at man's request. No venereal entries in health record. 2

One thousand two hundred and forty-three Kahn blood tests were done.

Three hundred and thirty-four dark field examinations were recorded. The low percentage (38) of diagnosed cases with positive dark field findings in this series was probably due to self-administered local treatment.

Due to organizational difficulties of a newly commissioned ship, treatment on board was not instituted until April, 1928. Since that time both mercury and neosalvarsan have been administered weekly. Thorough cooperation from the other departments and from the patients was somewhat lacking at first, but this was soon developed to a very gratifying degree.

A course of treatment consisted of eight injections each of mercury and neosalvarsan. The weekly average number of men receiving treatment, at first 20, grew to 40. Fluctuations naturally occurred during periods of intensive activity in the various departments, such as during target practice, engineering trials, and aviation training periods.

A total of 153 men received treatment, and of these, 127 remained on the ship long enough to receive more than one course. The average amount of treatment received was 20 injections of each drug for each man.

The total number of treatments given was as follows:

## Mercury:

Injections ..... 2,550

Rubs..... 661

## Neosalvarsan:

Intravenous injections ..... 2,517

In this series three men were found to be intolerant of arsenic. These men received extra amounts of mercurial treatment.

Mercury was pushed to tolerance in all the patients, rubs being added to the routine injections as indicated. One man was found who was salivated by minute quantities of mercury but who took arsenicals readily.

Due to the large number of syphilitics, the relatively limited facilities for treatment, and the necessity of adequate treatment of active disease, only recent infections and men with positive Kahn blood tests were handled. However, all others were given routine Kahn blood tests every four to six months. Ten previously quiescent cases

were detected in this manner and placed under treatment. Upon completion of a course of treatment a Kahn test was usually done to record the effect of treatment.

As a preparation for treatment the following routine was carried out weekly. Monday morning a urinalysis was done. Monday night the patient took a cathartic and went without breakfast Tuesday morning.

Mercuric injections were given each Monday morning. At first succinimide of mercury in doses of from gr.  $\frac{2}{5}$  to gr.  $\frac{6}{5}$  was used. Later bichloride of mercury in doses of gr.  $\frac{1}{5}$  to gr.  $\frac{3}{5}$  was used. After injection the patient vigorously massaged the injected area. The bichloride was found less painful to introduce, had a shorter period of postinjectional discomfort, and was, apparently, quite as effective as the succinimide.

Neoarsphenamine was given each Tuesday morning. The first dose was 0.3 gram, the second 0.6 gram, and subsequent doses each 0.6 or 0.9 gram, according to individual indications.

For initial injections one ampule was taken from the basin where it had been immersed in 70 per cent alcohol, and the contents dissolved in 65 cubic centimeters of sterile saline solution. After filtering, the solution was immediately drawn into three syringes, thus providing three doses of 0.3 gram, each dissolved in 20 cubic centimeters of saline solution.

Second injections were made by dissolving the contents of two ampules in 65 cubic centimeters of saline solution, providing three doses of 0.6 gram each.

The saline solution was prepared from ship-made evaporator water distilled in an electrically operated Bramwell still. Enough sodium chloride (C. P.) to make a 0.45 per cent solution was added, the solution filtered into clean flasks and sealed. The surface level of the liquid was marked on the flask. About half the quantity of distilled water was similarly prepared and placed in flasks. Both waters were then sterilized in the autoclave. Before mixing the neoarsphenamine solution the evaporated water from the saline flasks was replenished with the sterile distilled water to restore the original saline concentration. The syringes were filled by a corps man.

A second corps man cleansed and reesterilized the used syringes and needles. A third corps man checked the list, sterilized the skin, and manipulated the tourniquet.

As the syringes supplied have a central hub, it was found convenient to angulate the shaft of the needle about  $45^\circ$ , close to the hub, with the bevel on the convex side. Holding the syringe pen-fashion, entry of the needle into even the smallest vein and insertion of the shaft for a centimeter or two into the lumen was facilitated. Any

minor positional adjustments of patient or operator could be made without chance of getting the needle out of the vein. In fact, the syringe could be rotated through a wide arc. I found this very convenient when giving injections while the ship was underway in rough weather.

The number of syringes and needles prepared should be at least one-third of the number of men treated in order to allow efficient cleansing and reesterilization.

In all we had two or three patients who showed severe reactions to neosalvarsan. One developed a severe dermatitis even after 0.1 gram; the others developed gastrointestinal symptoms.

Late manifestations of syphilis noted among the cases on board were: A tabetic; a paretic; two men with iridocyclitis showing definite neuroretinal fundus lesions with scotomata of the visual fields; one case of iritis; a splenitis associated with a chronic nephritis and a strongly positive Kahn; a syphilitic endarteritis with a gangrenous toe, and an undetermined neurosyphilis.

The results were tangible and intangible. The latter were important. There was a definite improvement of morale both individually and collectively among this group of men. This could reasonably be attributed to the assurance given them that adequate treatment would be supplied; and to the improved health and well-being resulting from the treatment.

The objective results were manifested by the clearing up of specific lesions and improved physical condition of the men treated.

From the laboratory side as an indication of improvement under treatment the following table is submitted:

Originally	After treatment		
	To negative	To weak 1+ or ±	To repeated negative
4+	28	8	-----
3+	11	1	-----
2+	6	-----	-----
1+	-----	-----	19

#### CONCLUSIONS

1. The work can be done easily and safely by standardizing procedure and technique. After the initial inertia is overcome and the personnel trained the system tends to run itself.

2. It must be a continuous performance, week in, week out.

3. Few patients are more appreciative of treatment than syphilitics. They will cooperate heartily and sincerely with any routine which brings the desired treatment to them.





## RESERVE CORPS

### NEW APPOINTMENTS AND PROMOTIONS SINCE JANUARY 1, 1930

Name	Rank	Class	Appointed
Andrews, Edmund.....	Lieutenant Commander.....	MC-V(S).....	June 6, 1929
Ballengier, Irby Baxter.....	Lieutenant (Junior Grade).....	MC-V(G).....	Dec. 23, 1929
Cruickshank, Frank Sheppard.....	Lieutenant.....	MC-V(S).....	Jan. 6, 1930
Fulmer, Silas Crum.....	Lieutenant Commander.....	MC-V(S).....	Nov. 29, 1929
Goller, John Jerome.....	Lieutenant (Junior Grade).....	MC-V(G).....	Dec. 23, 1929
Jacobson, Sheldon Albert.....	do.....	MC-V(G).....	Feb. 15, 1930
Jones, Horace Croom.....	Lieutenant.....	MC-V(S).....	Jan. 15, 1930
Kerby, Walter Harold.....	Lieutenant Commander.....	MC-V(S).....	Jan. 30, 1930
Kilbury, Merlin Joe.....	do.....	MC-V(S).....	Jan. 27, 1930
Kler, Joseph Henry.....	Lieutenant (Junior Grade).....	MC-V(G).....	Dec. 10, 1929
Knowlton, Don Swett.....	Lieutenant Commander.....	MC-V(S).....	Jan. 4, 1930
Moon, Charles Roy.....	Lieutenant (Junior Grade).....	MC-V(S).....	Dec. 5, 1929
Norris, Jack Clayton.....	do.....	MC-V(G).....	Feb. 14, 1930
Rhinehart, Darmon Artelle.....	Lieutenant Commander.....	MC-V(S).....	Dec. 7, 1929
Strine, Howard H.....	Lieutenant (Junior Grade).....	MC-V(G).....	Feb. 7, 1930
Tegge, Charles William.....	Lieutenant.....	MC-V(S).....	Jan. 30, 1930
Vail, James B.....	Lieutenant (Junior Grade).....	MC-V(G).....	Feb. 1, 1930
Wilson, Merton Clarke.....	do.....	MC-V(G).....	Dec. 5, 1929

### PROMOTIONS

Name	From—	To—
Adams, John Q.....	Lieutenant (Junior Grade), MC-V(G).....	Lieutenant, MC-V(G).....
Anderson, August.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Anderson, Frank J.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Barner, Henry A.....	Lieutenant (Junior Grade), MC-F.....	Lieutenant, MC-F.....
Brown, Henry S.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Brown, James M.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Bullwinkel, Harry G.....	Lieutenant (Junior Grade), MC-F.....	Lieutenant, MC-F.....
Callaway, Guy D.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Constans, George M.....	Lieutenant, MC-V(S).....	Lieutenant Commander, MC-V(S).....
Corcoran, William J.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Davis, Delmar L.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Dement, Donald E.....	Lieutenant (Junior Grade), MC-V(G).....	Lieutenant, MC-V(G).....
Dockry, Lyman E.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Fackler, Charles L.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Freyman, John J.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Fuqua, Samuel A.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Ghormley, James C.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Hague, Robert F.....	Lieutenant (Junior Grade), MC-V(G).....	Lieutenant, MC-V(G).....
Hartman, George O.....	Lieutenant, MC-V(S).....	Lieutenant Commander, MC-V(S).....
Hennerich, Walter E.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Horner, Warren D.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(S).....
Huber, Paul R.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Jablons, Abraham.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Jackson, Harry H.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Jackson, Waddle P.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Jewett, Everett P.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Levin, Israel.....	Lieutenant (Junior Grade), MC-V(G).....	Lieutenant, MC-V(G).....
Loar, Ralph R.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Millett, George W.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Minaker, Andrew J.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Moore, William.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
McKitterick, John C.....	Lieutenant (Junior Grade), MC-F.....	Lieutenant, MC-F.....
O'Connoi, Denis J.....	Lieutenant (Junior Grade), MC-V(G).....	Lieutenant, MC-V(G).....
Remley, George C.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Reymont, Anthony E.....	Lieutenant (Junior Grade), MC-V(G).....	Lieutenant, MC-V(G).....
Roberts, Melvin D.....	Lieutenant (Junior Grade), MC-F.....	Lieutenant, MC-F.....
Ryan, Edward R.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Saska, August.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Segal, Samuel, jr.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Shaweker, Max.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Sheldon, Suel A.....	Lieutenant (Junior Grade), MC-F.....	Lieutenant, MC-F.....
Sullivan, Andrew J.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Tindall, Floyd G.....	Lieutenant, MC-V(G).....	Lieutenant Commander, MC-V(G).....
Waterman, Julius L.....	Lieutenant, MC-F.....	Lieutenant Commander, MC-F.....
Young, John G.....	Lieutenant, MC-V(S).....	Lieutenant Commander, MC-V(S).....



## NOTES AND COMMENTS

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### BUREAU PUBLICATIONS

On account of increasing printing costs, unaccompanied by any increase in the appropriation for printing and binding, the bureau publications have been seriously handicapped for more than a year.

The publication of the large index number of the *BULLETIN* in October, 1928, so depleted the funds of this appropriation that it was necessary in 1929 to combine the July and October numbers of the *BULLETIN*. Thus there were but three numbers of the *BULLETIN* published in 1929.

A similar situation was faced this year. It appeared that only three numbers of the *BULLETIN* could be published with the funds on hand. This condition was averted, however, by discontinuing the *Hospital Corps Quarterly* and publishing a July *BULLETIN* of about 60 pages less than the usual size.

During the fiscal year 1931 the *BULLETIN* will contain less than 200 pages each, and can contain only a very limited number of illustrations. Authors may expect to find their articles appearing with fewer illustrations than those submitted.

It is hoped, of course, that there may be forthcoming an appropriation which will permit the *BULLETIN* to resume its former size and some day even to appear as a monthly, as it has done during some periods of the past.

The new Supply Table and the Changes in the Manual are now being prepared.

The 1930 edition of the Handbook of the Hospital Corps, United States Navy, is also in the process of printing and should appear this month.

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### NEW STANDARD BOOK LIST FOR FISCAL YEAR 1931

Effective during the current fiscal year, a new standard list of books will form the supply table for all medical department activities except hospitals. Hospitals, as in the past, will not be limited to any list in their requisitions.

The new list is as follows :

- Textbook of Anatomy, Cunningham, 5th edition.  
Practical Bacteriology, Blood Work and Animal Parasitology, Stitt, 8th edition.  
Inorganic Pharmaceutical Chemistry, Rogers, 2d edition.  
Oral Anesthesia, Thoma, 3d edition.  
Dental Histology and Embryology, Noyes, 3d edition.  
Dental Formulary, Prinz, 3d edition.  
Dental Infections and the Degenerative Diseases (2 volumes), Price, 1923.  
Modern Dental Materia Medica, Pharmacology and Therapeutics, Buckley, 5th edition.  
Dental Pathology and Therapeutics, Burchard and Ingles, 7th edition.  
Dental and Oral Radiography, McCoy, 3d edition.  
Diseases of the Mouth, Mead, 4th edition.  
Medical Diagnosis for the Student and Practitioner, Green, 6th edition.  
Standard Dental Dictionary, Ottogy, 1923.  
American Illustrated Medical Dictionary, Dorland, 15th edition.  
Principles and Practice of Dermatology, Pusey, 4th edition.  
Dispensary, United States, Remington and Wood, 20th edition.  
Drill Book for Hospital Corps, United States Navy, 1920.  
The Nose, Throat, and Ear and their Diseases, Jackson and Coats, 2d edition.  
Food Analysis, Typical Methods and Interpretations of Results, Woodman, 2d edition.  
Fractures and Dislocations, Speed, 2d edition.  
Urology, Eisendrath and Rolnick.  
Hospital Corps Handbook, United States Navy, 1930.  
Naval Hygiene, Pryor, 1918.  
Manual for the Medical Department, United States Navy, 1927.  
Medical Compend for Commanders of Naval Vessels, 1923.  
Osler's Principles and Practice of Medicine, McCrae, 1927.  
National Formulary, American Pharmaceutical Association, 5th edition.  
Diseases of the Nervous System, Jelliffe and White, 5th edition.  
Practical Nursing, Maxwell and Pope, 4th edition.  
Operative Dentistry, Volumes I and II, Black, 5th edition.  
Manual of the Diseases of the Eye, May, 12th edition.  
Pharmacopœia of the United States, 10th edition.  
Principles of Pharmacy, Arny, 3d edition.  
Preventive Medicine and Hygiene, Rosenau, 5th edition.  
Fundamentals of Objective Psychology, Dashiell.  
Modern Surgery, General and Operative, DaCosta, 10th edition.  
Practice of Therapeutics, Hare, 21st edition.  
Diagnostics and Treatment of Tropical Diseases, Stitt, 5th edition.

A new list will be compiled annually.

As a large stock of Pryor's Naval Hygiene is on hand and this stock is not expected to be depleted before the appearance of some new edition of a Naval Hygiene, this book may be obtained "not on charge."

**RESEARCH IN SYPHILIS**

In the February, 1930, number of Venereal Disease Information appears the report of the chairman of the scientific committee of the board formed in 1928 for research in syphilis.

The plan evolved during the past year embraces four major groups of activities:

1. Studies of the biology of the infecting organism.
2. Studies of the reaction of the body to infection.
3. Experimental chemotherapy.
4. Clinical studies.

From among the many applications for grants received, the scientific committee has selected 20 which were made by scientists who are working in the leading universities and scientific institutions in this and other countries. Grants so far allowed amount to \$91,515.

Studies in the biology of the *treponema pallidum* including its cultivation in virulent form and the investigation of the possible existence of a life cycle of the organism are to be carried on by three different research workers.

The question of the existence of different strains of the treponema is of great importance, and will be the subject of further research. In this connection, the study of the tropical disease yaws is of special interest. A program has been agreed upon and is being carried out through the cooperation of the Medical Corps of the United States Navy at the base in Haiti. There are also being carried on in this country comparisons of the microscopic and gross pathology of yaws and syphilis, and a series of experiments to determine the cross immunity which one disease produces to the other.

The mechanism of latent infection and the pathologic condition of organs of persons who may have been cured of the disease are being studied, as well as the reaction of the tissues to infection and to antisyphilitic drugs.

Further research in the mechanism of the Kahn test and the Hinton test is being given financial aid. The possibility of eliminating lumbar puncture for the diagnosis of nervous system syphilis is another objective.

A special fund has been given for a detailed study of the results of treatment of syphilis. An appraisal of the relative value of different systems of treatment and of different kinds and amounts of drugs in the several stages of the disease is being made. For this work, there has been secured the cooperation of five clinicians who have a wealth of material for such a study at hand. The first problem which is being attacked is that of the results of treatment of early and latent syphilis.

This special fund has made possible also the American participation in a similar international study which is being sponsored by the League of Nations and in this country by the Public Health Service.

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#### PREVENTION AND CONTROL OF VENEREAL DISEASES

Surg. Gen. H. S. Cumming in a recent report to Congress states that the control of venereal diseases may still be regarded as one of the most important public health problems in this country to-day. From studies which have been made it is estimated that in spite of preventive measures which heretofore have been applied and the decrease in prevalence which must have taken place since the World War, there still are constantly under treatment or observation by physicians and in clinics in the United States approximately 474,000 cases of gonorrhea and 643,000 cases of syphilis. It is also estimated that 697,000 cases of gonorrhea and 423,000 cases of syphilis seek treatment for new infections in the course of a year. The economic importance of the loss of earning power and the cost of medical care occasioned by these diseases can be readily appreciated. Moreover, this does not take in account the tragedy of gonorrheal blindness among infants, the serious (often fatal) pelvic infections which occur among innocent women, and the thousands of cases of insanity due to syphilis.

The Public Health Service has continued its efforts to reduce the prevalence of venereal diseases, through cooperation with State and local health authorities, by the carrying on of educational work and the conducting of research in problems related to the treatment and control of syphilis and gonorrhea. New activities recently undertaken included an investigation of the syphilis problem among rural negroes in the Southern States and a campaign for prevention of venereal diseases among seamen in the American merchant marine and other beneficiaries entitled to treatment in the hospitals of the service.

State health authorities reported a total of 195,559 cases of syphilis and 156,544 cases of gonorrhea for the fiscal year 1929. Clinics operated under State supervision reported 120,315 new patients and 2,128,417 treatments.

The Public Health Service is now cooperating with the Committee on Research in Syphilis (Inc.), a philanthropic organization for the development and coordination of syphilis research, and with the health section of the League of Nations, in clinical studies of syphilis. Important progress has been made in special researches carried on during the year.

**THE COLON AS SITE OF FOCAL INFECTION IN CHRONIC PYELITIS, CYSTITIS,  
AND PROSTATITIS**

Dr. F. H. Redewill, Lieut. Commander J. E. Potter (M. C.), United States Navy, and Capt. H. A. Garrison (M. C.), United States Navy, writing in the March 8, 1930, number of the *Journal of the American Medical Association*, quote an extensive literature on colonic disorders as the cause of genitourinary-tract infections, and report 22 cases which did not respond to usual methods of urologic treatment, but which were cured by treatment directed to correct the colonic conditions.

They cite the work of Herter, which showed that many varieties of *B. coli* "readily distintegrate peptones into putrefactive products, such as ammonia, volatile fatty acids, phenol, indol, skatole, and hydrogen sulphide, causing acute symptoms and prolonged pathological effects." They cite the work of Bitter and Grundel which has shown that "nonhemolyzing *B. coli* infection is characterized by a chronic pyelitis that requires months or years to clear up."

Besides the series reported by the authors, they state that they have collected a large series of cases of nonspecific urethritis in which the infections were directly traced to the colon. In these cases the colon organisms showed a great preponderance of gram-negative bacteria. The urethral disturbances appeared during periods of aggravation of the colonic conditions, which in turn, the authors believe, were due to three etiologic factors, singly or in combination: (1) Infection in teeth, tonsils, sinuses, or bronchi; (2) an unusual state of putrefaction and diarrhea or constipation; (3) an acute or chronic colitis.

In treating the 22 cases reported (5 of pyelitis, 4 of cystitis, and 13 of prostatitis) the methods used were those of diet regulation, colonic irrigation, and administration of acidophilus milk.

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**THE HEALTH OF HAITI**

The Director General<sup>1</sup> of the Public Health Service of Haiti gives his annual report for the fiscal year 1928-29 the fitting title "The Health of Haiti."

This latest report is by far the most attractive one yet issued by the Haitian Public Health Service. The spot map of activities, the numerous and well-selected illustrations, the alluring account of the achievements of the year make this volume one that will be very highly prized by medical officers who have served in the Service d'Hygiene. For all those who have witnessed the activities of this service and who know something of its record and the magnitude and importance of its work, the report will contain abundant matter

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<sup>1</sup> Capt. K. C. Melhorn, Medical Corps, U. S. Navy.

of the deepest interest and will call forth a great world of rich recollections.

During the year the service passed all previous records in practically every aspect of its work.

There were 10,588 hospital admissions with a total of 340,300 hospital sick days. With rural clinics operating in 147 different localities, 1,341,596 out-patient treatments were supplied.

Injections for yaws-syphilis for the year reached the new high mark of 650,000.

Conspicuous among the accomplishments of the year was the organization of the traveling-clinic unit which was conducted by Drs. P. W. Wilson, United States Navy, M. S. Mathis, United States Navy, and C. L'hérisson.

At Gonaïves a new ward, kitchen, and mess hall were built. At Petit Goave a building for polio patients was erected. The hospital grounds at St. Marc were doubled in area by purchase of adjoining property. At Jérémie the hospital chapel was completed.

The rebuilding program in the areas of the southern peninsula devastated by the hurricane of 1928 was completed.

The anatomy-pathology building of the medical school was completed and equipped.

The first health center was established in Port au Prince. The principal work of this center includes infant welfare, prenatal and postnatal care.

Rockefeller Foundation fellowships were granted to 11 members of the medical-school faculty for studies to be pursued in France, Canada, the United States, and Porto Rico.

American personnel were withdrawn from 4 of the 10 sanitary districts (Port de Paix, St. Marc, Jérémie, Petit Goave) and their places filled by Haitian physicians and inspectors.

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#### DANISH TREATMENT OF SCABIES

In the January 25, 1930, number of the British Medical Journal, Dr. Alexander Cannon reports on a method of treatment which was instituted in 1911 by Doctor Marcussen and has since been widely used and known as the Danish treatment. It has been extensively used in the Navy, where its employment has usually resulted in cure in one day.

The preparation of the ointment is somewhat complicated and requires some care to insure a perfect result. Marcussen prepares it as follows:

I. One liter of sublimated sulphur is dissolved by heating it gently in 1 liter of a 50 per cent solution of potassium hydroxide, a clear yellow solution resulting.



II. Two hundred and twenty-five grams of vaseline and 225 grams of water-free lanoline are mixed with care, no heat being used.

III. To this mixture 375 cubic centimeters of the solution of sulphur in potash lye (see I) is added.

IV. Fresh zinc hydroxide is prepared by mixing 28 grams of zinc sulphate and 40 cubic centimeters of a 20 per cent solution of sodium hydroxide. Then this is added to the ointment.

V. Liquid paraffin is added to make a total weight of 1,000 grams.

VI. Five grams of benzaldehyde is added to check the somewhat disagreeable smell of sulphuretted hydrogen.

The ointment kills the adult mite within a half hour and the eggs within 24 hours.

The treatment is carried out as follows:

1. The patient takes an ordinary cleansing bath.
2. He applies the ointment to the whole of the body, except the head, by gentle rubbing only. Some one will assist him in anointing the back.
3. He waits for 20 minutes to allow the application to soak in.
4. He may then remain in pajamas until the next day.
5. Twenty-four hours after receiving the application of the ointment, the patient receives his second bath.
6. He puts on fresh underclothing and walks away cured.

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#### SCARLET FEVER

Seven years ago the Dicks began the publication of a series of experiments which established a specific type of hemolytic streptococcus as the cause of scarlet fever. All of their conclusions as to the etiology, specific toxin, and antitoxin of scarlet fever have since been verified by numerous reports by others, including the reports by Nicolle, who repeated, at the Pasteur Institute at Tunis, all the crucial experiments of the Dicks, including even the experimental production of scarlet fever in human beings.

In the January, 1930, number of the Illinois Medical Journal, Gladys Dick reports an excellent summary of the findings to date. With not a single superfluous word, she has included in four pages more accurate and practical and valuable information on the subject and more convincing proof of the great worth of the new procedures in scarlet fever work than has ever been noted in any other article, regardless of its length. This work is now universally recognized as one of the outstanding contributions in preventive medicine during the present century.

Scarlet fever toxin and the corresponding antitoxin have furnished the means for controlling the disease through the development of:

1. A method of identifying scarlet fever streptococci.

2. Control of quarantine by means of nose and throat cultures on blood agar plates.
3. A skin test for determining susceptibility to scarlet fever.
4. A method of active immunization of susceptible persons.
5. An antitoxin specific for scarlet fever for use in the treatment and in the prevention of the disease.

Conclusions in this article are based on observations made in a series of 32,440 persons subjected to skin tests, and on 11,584 susceptible persons who were immunized against scarlet fever by injection of graduated doses of the sterile toxin, and on groups of susceptible persons found to be infected after exposure who were given prophylactic doses of antitoxin. Results are also reported on a series of 967 cases of scarlet fever in which the antitoxin was used therapeutically.

The reliability of the skin test for susceptibility is shown by the results in 20,856 persons with negative reactions who passed through one to several epidemics without contracting the disease. In a group of 2,157 nurses and internes with negative skin tests, none of the group contracted the disease, although exposed to it on contagious disease wards.

Differences in the intensity and size of the skin reactions correspond to differences in degree of susceptibility and indicate that, in many persons, immunity to scarlet fever is acquired gradually through repeated infections with scarlet-fever streptococci without the development of a typical attack of the disease.

Active immunization with sterile toxin in 12,775 susceptible persons caused no injury in any instance. As much as 20 cubic centimeters of undiluted toxin, containing nearly 1,000,000 skin-test doses, has been injected experimentally without causing injury or producing nephritis in human beings.

The doses of sterile toxin for active immunization should be graduated, beginning with 500 skin-test doses in the first injection and increasing to eighty or one hundred thousand skin-test doses in the last injection. The injections are made subcutaneously at intervals of one week. If the full amount is given in each dose, the five doses may be counted on to immunize completely 95 per cent of susceptible persons and to considerably modify the susceptibility of the remainder. Two weeks after the last dose is given, another skin test is made, using one-tenth cubic centimeter of the skin-test solution, or one skin-test dose, on the right arm and two-tenths cubic centimeter, or two skin-test doses, on the left arm. If the reaction on either arm is positive, the fifth dose is repeated.

Unless the immunization is carried to the point of a negative skin test, complete protection against scarlet fever can not be expected; though the severity of a subsequent attack of scarlet fever would be modified by the partial immunization.

The duration of active immunity as well as the degree of immunity depends on the amount of toxin injected. Retests made at intervals of one, two, and three years indicate that more than 90 per cent of those immunized to the

point of an entirely negative skin test retain their immunity. Between 5 and 9 per cent slip back and require a second immunization.

Conditions in institutions where the disease is epidemic are favorable for determining the efficacy of active immunization in controlling scarlet fever. A number of such institutions have been under observation during the past six years. Skin tests were made on every one and the susceptibles were immunized with graduated doses of toxin. No case of scarlet fever has occurred among 11,584 susceptible persons immunized in institutions where scarlet fever was epidemic. Controls were furnished by typical cases of scarlet fever developing in newly admitted persons who had not been tested and immunized before they were introduced into the infected community, and by cases of scarlet fever in teachers and attendants who refused immunization. \* \* \*

By the use of nose and throat cultures on blood-agar plates, skin tests for susceptibility, active immunization with the toxin, and use of antitoxin prophylactically in infected susceptibles, it is possible in a group, small enough to test and culture in one day, to bring an epidemic of scarlet fever under control in 48 hours.

The passive protection conferred by a prophylactic dose of any antitoxin is transient, lasting at the most two to three weeks. Active immunization with the toxin should be begun in the infected susceptibles one week after the prophylactic dose of antitoxin is given.

In the therapeutic use of the antitoxin, the success is proportionate to the stage of the disease when the antitoxin is given. Given early and in adequate dosage, brilliant results may be expected. "The patient sometimes recovers so promptly that the attending physician wonders if he could have been mistaken in the diagnosis of scarlet fever."

Even when there has been a delay in the administration of the antitoxin, it will reduce the incidence and severity of complications. Mastoiditis occurred three times as frequently in a control series as in an antitoxin series; the incidence of post scarlatinal nephritis in the control series was four times that in the antitoxin series, and the death rate in the control series was twice that in the antitoxin series.

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#### A CLINICAL STUDY OF MENINGITIS

As meningitis has been more prevalent in the Navy during the last two years than at any time since 1919, it is now viewed in the service as a disease of great importance. During the calendar year 1927, 14 deaths from meningitis gave it seventh place on the list of diseases causing deaths in the Navy, and during 1928, with 27 deaths, it took second place. During 1929, 20 deaths from meningitis occurred in the Navy, placing the disease in first place as a cause of death during the year. During the last two years the Bulletin has printed numerous articles and abstracts on the subject.

In the January (1930) number of the American Journal of Medical Sciences M. P. Borovsky reports an analysis of 190 cases of meningo-

coccus meningitis observed by him during an 18 months' period (from April, 1927, to October, 1928) at the Cook County Hospital, Chicago. He points out the cyclical appearance of epidemics of meningitis in New York and Chicago, the waves appearing about every 9 to 12 years. (This has been the experience in incidence in the Navy—a marked decline in the prevalence may reasonably be expected this year, and the next large rise may be looked for about 1940.)

In Borovsky's series, headache, vomiting, and fever were universal symptoms; and rigid neck, Kernig and Brudzinski signs were found in every case except in infants under 1 year of age.

The cases with petechiae were the most severely toxic. This symptom was noted in 28 cases, and the mortality in this group was 64 per cent (or 14 per cent greater than the rate for the entire series).

Herpes labialis occurred in 19 cases (10 per cent) and was most frequent in the recovered cases. Strabismus was present in 24 cases (12.5 per cent), and was slightly more frequent in the recovered than in the fatal cases.

Deafness was the outstanding sequela (in 25 per cent of the cases). The type was complete loss of hearing from nerve involvement. In a few cases it was noted at the onset of the infection. No improvement in hearing occurred in any of the cases where deafness developed.

Patients with extreme opisthotonus usually remained clear mentally. They showed a prompt response to serum therapy and a relatively good prognosis.

The mortality for the series was 48.9 per cent.

"It was interesting to note that the duration of the illness before admission was not as important a factor as is ordinarily believed. The patients who received treatment before the end of the first week of illness had a much better chance of recovery, however, than those who were ill seven days or more before treatment was instituted."

In only 6.76 per cent of the cases was there failure to find the organisms in the spinal fluid.

The average cell count on admission was 11,780; the lowest was 980, the highest 90,000.

The blood showed a leukocytosis in every case, the average count being 23,700.

Polyvalent serum was used. No difference in therapeutic value was noted among the different brands, but "in a few instances definite improvement was not apparent until a change had been made from one brand to another." Borovsky suggests that the choice of serum be made after the agglutinating power of the various sera is tested for the particular strain of organism causing the infection.

Treatment consisted of daily intraspinal injections of serum until the fluid became clear. Cisterna puncture was used in 12 instances (when the opisthotonus was so marked that spinal puncture could not be done).

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#### PREPARING THICK FILMS FOR DIAGNOSIS OF MALARIA

The studies conducted by the United States Public Health Service relating to the prevention and eradication of malaria assume many interesting phases. A recent report of considerable interest issued by the service is that relating to a method of preparing and examining blood smears for the diagnosis of malaria.

Laboratory workers and others interested in the diagnosis of malaria have recognized the advantages of the thick-film method, especially for malaria surveys. An assistant may be easily taught to collect good specimens, and the method has been used widely and is successfully used in field work. Much time is saved in the examination of specimens. When the malaria parasites are at all numerous they are usually seen in the first thick film; when they are rare they are often detected in the thick film when they might have been missed in a thin film or found only after a long search. The chief purpose of the thick film is, of course, the diagnosis of malaria rather than the study of the characteristics of malaria parasites, a purpose for which the thin film is more suitable.

It is commonly recommended that 15 to 20 minutes be devoted to a thin film before it is declared negative and 5 minutes to the thick film. In either case the time spent on apparently negative specimens must vary with the circumstances. When, for example, the sole purpose is to find a crescent carrier suitable for mosquito-infection experiments, a fraction of a minute will suffice for the thick film. In a clinical case it may be necessary to spend a good deal of time on a film; but here it is usually possible to get a new specimen taken at a time when parasites may appear in larger numbers.

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#### HEALTH CONDITIONS IN THE UNITED STATES DURING THE PAST FISCAL YEAR

A summary of health conditions in the United States during the past fiscal year is included in a report recently submitted to Congress by Surg. Gen. H. S. Cumming, of the Public Health Service. This report indicates that bubonic plague was reported in California and the islands of Hawaii during the fiscal year.

Preliminary reports show that the birth rate in the United States birth registration area for the calendar year 1928 was lower than in

1927, while the death rate was higher. The figures for births were: 1927, 20.7 per 1,000; 1928, 19.7 per 1,000. For deaths, 1927, 11.4 per 1,000; 1928, 12.1 per 1,000. The infant mortality rate for 1928, 67.9 per 1,000 births, was higher than in 1927, 64.6 per 1,000 births.

The outbreak of influenza, which began in the spring of 1928, decreased as usual during the summer months and flared up into epidemic proportions during the fall of 1928, was responsible for much, if not all, of the increase in the death rate for the calendar year 1928. In the fall the epidemic was first reported on the Pacific coast and then spread rapidly eastward, reaching its peak for the country as a whole about the first of the year 1929.

The disease in many parts of the country was so mild that physicians hesitated to report it as influenza and many cases were considered to be merely severe colds and were not seen by physicians. However, the general death rate rose far above the normal during the epidemic, which did not continue for many weeks in any one place.

Surveys conducted by the Public Health Service in certain States concerning the influenza epidemic of 1928-29 showed that nearly 15 per cent of the population canvassed in various localities gave a history of having suffered attacks of influenza or grippe, while 0.47 per cent gave a history of pneumonia and an additional 14 per cent reported colds which may or may not have been directly related to the epidemic.

During the calendar year 1928, 38,000 cases of smallpox were reported in the United States; in 1927, 35,000 cases were reported. It seems strange that year after year more cases of smallpox are reported in the United States than in any other country of the world except British India, yet this disease can be controlled by vaccination and revaccination and with the cooperation of the public could be stamped out in the course of a few years.

More cases of cerebrospinal meningitis were reported during 1928 than have been reported since 1918. This disease appears to increase and decrease in swells of several years' duration and for the last five years it has been increasing.

The record for the calendar year 1928, shows a new low death rate for typhoid fever. This disease was responsible for 34 deaths per 100,000 population at the beginning of the present century. The mortality has decreased until, in 1928, 43 States reported only 5,425 deaths, giving a death rate of 4.8 per 100,000. This reduction of 86 per cent in the death rate from typhoid fever has been brought about largely through the practical application of the principles of modern sanitary science. Health officers and others interested in sanitation, who have had a part in this work, may well be proud of the results accomplished.

Tuberculosis, which has been decreasing since the beginning of the century, when comparable annual records of deaths were first published, showed during the year 1928 the lowest general death rate ever recorded by the Public Health Service for that disease. The death rate for 1928 was 77.5 per 100,000 population. In 1900, in the death registration area, the death rate from tuberculosis was more than 200 per 100,000.

The number of deaths from pellagra in 43 States increased from 4,794 in 1926 to 6,652 in 1928. The death rates range for 1928 from 50 per 100,000 in South Carolina and 42 in Mississippi, to less than one-tenth of 1 per 100,000 in several States. The disease is more prevalent in rural districts than it is in the cities, and Southern States have higher rates than Northern States.

Incomplete reports show that undulant fever is much more prevalent in the United States than had been realized. Reports from many sources, some of them not official, show that there were at least 649 recognized cases of undulant fever in the United States in 1928.

Four hundred and eighty cases of tularaemia with eight deaths were officially reported to the Public Health Service for the year 1928. Many cases of this disease are not reported.

Typhus fever is another disease for which the reports are incomplete. The mild form of this disease (sometimes called Brill's disease) was prevalent during 1928, especially in the Southeastern States. One hundred and forty-three cases, with 12 deaths, were reported to the Public Health Service.

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#### AMERICAN ASSOCIATION FOR STUDY OF GOITER

Beginning this year the American Association for the Study of Goiter will award a cash prize of \$300 annually for the best original thesis dealing with some phase of the goiter problem. Theses should be submitted by June 1 to Dr. Walter M. Simpson, chairman of the essay committee, Miami Valley Hospital, Dayton, Ohio. The award will be given immediately following the coming meeting of the association, which is to be held in Seattle, Wash., July 10-12, 1930.

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#### FIFTEENTH ANNUAL CLINICAL SESSION OF THE AMERICAN COLLEGE OF PHYSICIANS

The American College of Physicians will hold its fifteenth annual clinical session at Baltimore, Md., from March 23 to 27, inclusive, 1931. The Lord Baltimore Hotel will be headquarters.

Dr. Sydney R. Miller, Baltimore, as president, will have charge of the selection of the general scientific program. Dr. Maurice C. Pincoffs, of Baltimore, has been appointed by the board of regents as the general chairman of the session, and will make all local arrangements, including the making up of the program of clinics. Business details will be handled by the executive secretary, Mr. E. R. Loveland, from the college headquarters, 133-135 South Thirty-sixth Street, Philadelphia, Pa.



## BOOK NOTICES

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Publishers submitting books for review are requested to address them as follows:

The Editor,

UNITED STATES NAVAL MEDICAL BULLETIN,  
Bureau of Medicine and Surgery, Navy Department,  
Washington, D. C.

(For review.)

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THE HUMAN MIND, by *Karl A. Menninger, M. D.* Alfred A. Knopf, New York, 1930. Price, \$5.

The general reader has not fared well in what has been served to him in the way of books touching on subjects which belong to one section or another of the field of medicine. Everyone who has tried to read them has been struck with the grossness of their faults. There have been a few striking exceptions during the present century, but the mass of these books have been pretty terrible.

The soup has been either too thin—the books didn't tell anything, they were compilations of platitudes, or they were tiresome through the writer's too apparent lack of grasp of the matter—or too thick—they were too technical, too abstruse and bewildering for general reading—or too unauthoritative—they were loaded with hokum and fustian, and propounded the pet but untenable or impossible theories of their authors—in a certain parlance, their "boloney" content was very high.

Those that posed as works on things psychiatric or psychologic were by far the most numerous—and the most awful. Once in a great while something solid and authentic appeared on mental problems; something readable and sound and stimulating and enlightening—but usually these were of no great value to the physician (except to lend to some of his patients with mental troubles) because they were too elementary or were presented in a way which did not meet his needs or arouse his interest.

No one saw this situation more clearly or felt it more keenly than Doctor Menninger. He saw it and felt it as a medical student, through his years of practice as a psychiatrist, and, perhaps most, as a teacher of psychiatry. He saw the need of explaining many things

in simple terms, in a form that would suit lawyers, students, patients, patients' relatives, doctors, and a great mass of intelligent persons—discriminating readers who want to acquire a share of information on the subject of the human mind; who want to know what all this talk of psychiatry and mental hygiene and personality studies is about.

He has written the book. In the introduction he states what he has tried to do: "I have tried to put down in a systematic fashion the conception I have of the human personality. I have tried to keep it objective and specific and to write it so it can be understood."

He has done all this; and he has done it so admirably, skillfully, completely; he has written so much experience and understanding into it, and has displayed in it so clearly and vigorously and so favorably the views of the younger group in American psychiatry that no one can possibly fail to see the preeminence of the book.

One of the impressive perfections of the book is Menninger's choice of passages from literature—passages which illustrate with neatness and force the themes he is developing. Prefacing the introduction, he quotes a page from Maxim Gorki's *Two Stories*—which expresses the greater interest and warmth one finds in persons who are not too "normal." To preface the chapter on Personalities, he chooses a page from Samuel Butler's *The Way of All Flesh*. He starts his chapter on Applications with a notable passage from E. E. Southard's *The Kingdom of Evils*.

The chapter on Principles gives the reader the essential background of psychiatry and a reliable perspective of modern psychiatry.

Under Personalities, Menninger introduces us to the constituents of personality and tells "what happens when a *personality* meets a *situation*"—whether there will be an attack or a retreat; success, failure, or compromise. At some length and with the utmost precision, always illustrating by well-chosen (and spicy) case histories, he describes and explains the different types of personalities.

Under Symptoms, he dissects the mental wrecks and shows the parts of which they are made.

Under Motives, he shows the forces that create the symptoms.

Under Treatments, he gives no rules of thumb, no platitudes. "It's a problem of discovering the weaknesses in the personality make-up, and the difficulties in the situation." He shows the great place of medicine and of surgery in the treatment of some of the disorders and gives his readers a clear view of the parts and purposes and importance of psychotherapy. "To be bored or annoyed or disgusted by the fancies and failures and queernesses of 'nervous' people is to be foredoomed to failure."

The chapter on applications is a philosophic section, dealing with the extensions of psychiatric theory. Four fields of application are

discussed—educational, industrial, legal, and medical. Under “educational applications” he deals with such subjects as the failure of teachers to appraise properly the importance of the various symptoms of mental troubles; the limitations placed by the “system” of schools on the efforts to cope with mental problems of pupils; the significances of “flunking,” of “necking,” immorality, and “datelessness” in college students.

Under “legal applications” he writes his most appealing philosophy. He gets away from the idea of justice. “What science or scientist is interested in *justice*? Is pneumonia just? Or cancer? What criteria of ‘justice’ can be applied to a broken arm or a weak mind? The scientist is seeking an amelioration of an unhappy situation. This can be secured—not by debating philosophical concepts of a primitive theology.” Here he presents the very progressive proposal made by former Gov. Alfred Smith to the New York State Crime Commission, and the recommendations of the section on criminal law of the American Bar Association.

Under “medical applications” there is an outline of the relation of psychiatry to the general practice of medicine. Most of this section appeared in the *Naval Medical Bulletin* for April, 1929, under the title of “Fundamentalism and Modernism in Psychiatry.”

This reviewer shares the opinion of Carl Van Doren, who says: “Karl Menninger’s *The Human Mind* is calculated to interest any reader who has a mind. What gives his book its special value is the number of case histories which he includes. He has not dealt in abstract terms, but has told the stories of real persons, and has told them in the language of common experience. They are as interesting as fiction and are told with an art that brings out their full interest.”

**HUMAN BIOLOGY AND RACIAL WELFARE**, by various contributors. Edited by *Edmund V. Cowdry, professor of cytology, Washington University, St. Louis.* Paul B. Hoeber (Inc.), New York, 1930. Price, \$6.

If one is in search of a broad education in the problems of human life; if one wishes to acquire a breadth of view; if one desires a “proper introduction” to a group of sciences which concern human welfare and which are known collectively as “human biology”; if one wants the intimate story, the vital, important facts of the aims, the significance, the accomplishments, the purposes, the interrelationships of these sciences—here it is between the covers of this book.

Here the meat and the cream are served up in a form that will fascinate and satisfy and delight any mind capable of being penetrated by sound ideas which have to do with the cold facts of human life.

To students who are about to specialize and who wish to see in perspective what lies ahead, the book supplies exactly, vividly, just

this perspective. The present trend of "adult education," the bringing to the mature reader, occupied with business as well as science, the acquaintance with modern biologic thought and endeavor which his inquiring mind can not resist seeking, will gain some great aid and momentum through the medium of this incomparable book.

Edwin R. Embree, in a 7-page introduction, undertakes to tell what the book is about. He more than succeeds in this; he presents such an intriguing bird's-eye view that one pushes immediately on through the following pages to see if Embree is telling the truth, if the book fulfills what he promises. While Embree's style may be more delightful than that of some of the contributors, he certainly does not overstate the case—almost without exception each chapter is quite as rewarding as we are lead to expect from the introduction. Embree states no less honestly than neatly that "This book is one answer to the lament of H. G. Wells when he says, 'If only the scientists would tell us less *mumbly* what it is all about!'"

The following paragraph from Embree's introduction holds a good glimpse of what is in the book.

Biologists with a background of statistics are bringing in information concerning wide tendencies in disease and death, in population growth, and potential evolution. Men called anthropologists are searching out the history of past races and the life and habits and customs of living peoples in diverse parts of the earth, and by putting together all this information they give us some idea of the directions in which we are developing and of ways in which we may shape the course of our own progress. Sociologists and political scientists and economists are beginning to glean objective evidence of the ways we live together and act in group life. Psychologists and psychiatrists are delving into our minds—even our subconscious thoughts and emotions.

There are 27 contributors. The list is virtually a list of some of the best minds in America and England occupied with biologic sciences. The following 10 have contributed chapters which strike this reviewer as having particular appeal: Walter B. Cannon, Alexis Carrel, Edmund V. Cowdry, Charles B. Davenport, John Dewey, Haven Emerson, William Healy, Raymond Pearl, Sir Charles S. Sherrington, Hans Zinsser.

If the reader thinks he can not find the time to read all of the 600 pages, he may read E. R. Embree's Introduction, John Dewey's chapter on The Influence of Education, and Raymond Pearl's chapter on Some Aspects of the Biology of Human Populations—he will then find the time to read the rest of the book if it takes all night.

A TEXT-BOOK OF INORGANIC PHARMACEUTICAL CHEMISTRY FOR STUDENTS OF PHARMACY AND PHARMACISTS, by Charles H. Rogers, D. Sc. in Pharm., Professor of Pharmaceutical Chemistry in the College of Pharmacy, University of Minnesota. Lea and Febiger, Philadelphia, 1930. Price, \$7.00.

This is the latest American book on the subject and is an excellent work both from the standpoint of the presentation of the subject

matter and the mechanical features of paper, print, binding, and illustrations. Each element is considered under the headings of:

- History and Occurrence.
- Properties.
- Tests for Identity.
- Commercial Methods of Manufacture.
- Laboratory Preparation.
- Quantitative Preparations and Uses.
- Pharmaceutical Preparations and Uses.

Under the latter heading Dr. A. D. Hirschfeld has contributed a brief but excellent note on the pharmacologic action of the various ions.

The book, while intended for the general student who has had elementary chemistry, nevertheless follows so direct and orderly a plan that a very little knowledge of the subject is required to enable one to find it a most useful work. To Hospital Corps men who have graduated from one of the Hospital Corps schools it should prove of great value both as a guide in the study of a regular course in inorganic chemistry and as a reference work. The inclusion of all the official preparations of the United States Pharmacopoeia and the National Formulary with the official Latin and English titles and the constant reference to the Pharmacopoeia particularly in the qualitative and the quantitative tests and official assays makes it most serviceable to the pharmacist and pharmaceutical student.

**THE MECHANISM OF THE LARYNX**, by V. E. Negus, M. S., London, F. R. C. S., England, Junior Surgeon for Diseases of the Throat and Nose, King's College Hospital, London. The C. V. Mosby Co., St. Louis, 1929. Price, \$13.50

This is a superb monograph on the larynx, representing a life's work of a man who has approached his problem from every conceivable angle; a man to whom a decade meant no more than a minute so long as there was a hope of finding the answers to the questions he had been asking himself during the years of his research.

This is the work of a profound and able student of the comparative anatomy and physiology of the larynx; a man who has understood and adhered to all the highest ideals and traditions of scientific research. One can not examine the book and fail to see the forces that have driven the author, or the constancy and zeal and skill with which he has done his work.

The book is far too large and great and comprehensive to permit here any detailed discussion of its contents. The author has reported in minute detail his exhaustive studies of the evolution of the larynx, the modifications for respiration, deglutition, and for regulation of intrathoracic pressure. Finally there are lengthy chapters on Pur-

positive Use of Sound in Relation to Hearing, Employment of Sound as a Means of Communication, Mechanism of Phonation, Physiological Anatomy of the Human Larynx.

Laryngologists who wish to probe all the intricacies and depths of the subject may find here a wealth of reading which could quite occupy one throughout the spare moments of a year's time.

**TONSIL SURGERY**, by *Robert H. Fowler, M. D., Fellow of the New York Academy of Medicine; Fellow of American Medical Association; Chief Surgeon of the Tonsil Hospital, New York; Junior Surgeon (Throat Service), Assistant Surgeon (Ear Service), at Manhattan, Eye, Ear, Nose, and Throat Hospital.* F. A. Davis Co., Philadelphia, 1930. Price, \$10

This is a beautiful book. It reaches many artistic heights. Its author is a master, and here he shows what may be done in the perfection of scientific books.

The photographs and anatomic sketches are unexcelled and illustrate the text precisely, elaborately, admirably. The printing and paper are of the high quality which befits Doctor Fowler's masterly treatise.

"The tendency to slight the importance of accurate technic in tonsillectomy is becoming less as the desirable results of mechanically skillful operations become more apparent." Here, if anywhere, one can find "accurate technic" accurately described, and here one finds justification for the author's statement that in point of mechanical perfection the operation of tonsillectomy approaches a level where it may be "comparable to the art of setting jewels."

The dissections for the illustrations were done by Mr. Harry Beecher; the paintings are by Alfred Feinberg and the late William J. Brownlow. Mr. Brownlow's tragic death in the Cleveland Clinic explosion prevented his seeing in their final form the exquisite drawings which play such an important part in the book.

The chapter divisions are as follows: Anatomy, Structure, Physiology, The Rise of the Tonsil Operation, Why and When the Tonsil Should Come Out, Classical Operations, Automatic Instruments, Semisharp Dissections Without Snare, Sharp Dissection Without Snare, The Author's Operation, The Relative Value of the Various Operations and Their Relations to the Anatomy, Research in Tonsil Anatomy, Complications, Hemorrhage, Anesthesia, The Tonsil After Surgical Removal, Microscopic Study, Hospital Care of Patients, Follow-up Reports, Evolution, Review and Conclusions.

**THE MOBILIZATION OF ANKYLOSED JOINTS BY ARTHROPLASTY**, by *W. Russell MacAusland, M. D., Surgeon in Chief, Orthopedic Department, Carney Hospital, and Andrew R. MacAusland, M. D., Orthopedic Surgeon, Carney Hospital, Boston, Mass.* Lea and Febiger, Philadelphia, 1929. Price, \$4.

The MacAuslands have written a splendid and highly valuable book. In 250 pages they convince the reader that arthroplasty has

deservedly become a standardized form of treatment for the mobilization of ankylosed joints.

The book should be extremely helpful in giving a wider understanding of the subject, authoritative information on the technique of the operations, and in the selection of cases.

**PEPTIC ULCER**, by *Jacob Buckstein, M. D., Instructor in Gastrointestinal Röntgenology, Cornell University Medical College; Alimentary Tract Division, Röntgen Department, Bellevue and Beth Israel Hospitals, Consultant in Gastroenterology, United States Veterans' Bureau, etc.* Paul B. Hoeber (Inc.), New York, 1930. Price, \$12.

This is one of a series of 10 monographic atlases edited by James T. Case and published by Paul B. Hoeber (Inc.).

It is the last word in the high art of atlas making and brings to its possessor a postgraduate course that he can pursue whenever he likes and as often as he likes. Many years will pass before such a collection of graphic and textual information on the subject will or can be eclipsed.

There are 287 X-ray photographs, most of them accompanied by case histories or other explanatory matter.

The book should be of the greatest aid in interpreting the obscure lesions, and in ascertaining the various pitfalls upon which erroneous interpretations both positive and negative may be based.

The main division of the book is into the gastric ulcer section and duodenal ulcer section. There is a well-added chapter on gastro-jejunal ulcer and gastro-jejuno-colic fistulæ.

**A TEXTBOOK ON ORTHOPEDIC SURGERY**, by *Willis C. Campbell, M. D., F. A. C. S., Professor of Orthopedic Surgery, University of Tennessee, College of Medicine; Attending Orthopedic Surgeon, Baptist Memorial Hospital, Methodist Hospital, St. Joseph's Hospital, Home of Incurables, Porter Home and Leath Orphanage; Chief of Staff, Crippled Children's Hospital, and Hospital for Crippled Adults, Memphis.* W. B. Saunders Co., Philadelphia, 1930.

Although this is a valuable book for the orthopedic surgeon, it is written primarily for the student, the general practitioner, and the general surgeon. The concise and simple way in which it is written is bound to make it a favorite. The various orthopedic conditions are dealt with in such a manner that the text is easily grasped, even by those not especially trained in orthopedic work.

Doctor Campbell has eliminated a great deal of the unnecessary discussion on the unusual methods of treatment of the various orthopedic conditions, and gives us the treatment, that from his vast experience has proved the most efficient. The book is very well illustrated, is easily read, and the small volume of less than 700 pages contains an immense amount of information.

The chapters on "Routine Examination of the Extremities and Spine" and "Application of Apparatus" are bound to help one in

the routine examination and treatment of patients. The author has also broadened the scope of the specialty and included chapters on dislocations and fractures. These chapters are in keeping with the rest of the book.

This book will especially appeal to the general surgeon who must occasionally handle an orthopedic case. For the naval medical officer aboard ship, or in an out-of-the-way place where everything that comes along must be cared for, it will be invaluable.

**SURGICAL DIAGNOSIS**, by *American Authors* edited by *Evarts Ambrose Graham, A. B., M. D., Bizby Professor of Surgery, School of Medicine, Washington University, St. Louis; Surgeon in Chief to Barnes and Children's Hospitals and to Washington University Dispensary, St. Louis.* Volumes I and II. W. B. Saunders Co., Philadelphia, 1930.

In this 2-volume work the editor has been ably assisted by 42 authors of prominence throughout the United States. The work is almost entirely given over to surgical diagnosis with discussion on the etiology and pathology of the various surgical conditions. Only occasionally is the treatment of these conditions alluded to.

Doctor Graham points out the fact that the remarkable development in the art of operative surgery has led the public to place great faith in the therapeutic possibilities of surgical operations, which in turn has led to the temptation to perform operations often on insufficient grounds. He impresses upon us the crying need for more thorough study of our cases before operation, and the material is presented in a way that is best suited to assist us in arriving at the proper diagnosis.

Special emphasis is placed on the strictly clinical phases of the subject but not to the exclusion of the methods of laboratory examinations which are considered useful and practical.

The work as a whole is so comprehensive that it is difficult for a reviewer to point out the outstanding features. However, one is forcibly impressed by the chapters on "Joint Diseases and Injuries" by Dr. Nathaniel Allison; "Gynecological Diagnosis," by Dr. A. H. Curtis; "Diseases of the Stomach and Duodenum," by the Doctors Horseley; and "Diseases of the Peritoneum," by Dr. Arthur E. Hertzler.

The work comprises some 1,900 pages and contains 1,250 illustrations. The subject matter is exceptionally well presented by outstanding specialists in the various branches.

The internist as well as the surgeon should make room in his library for these two volumes.



**VARICOSE VEINS**, by *H. O. McPhaeters, M. D., F. A. C. S., Director of the Varicose Vein and Ulcer Clinic, Minneapolis General Hospital; attending physician New Asbury, Fairview, and Northwestern Hospitals, Minneapolis, Minn.* Second edition. F. A. Davis Co., Philadelphia, 1930. Price, \$3.50.

This book was accorded such a generous reception that the second printing was exhausted in less than five months.

The first edition was reviewed in the January number of the **BULLETIN**.

This second edition, appearing within a year of the first edition, is more complete and contains many improvements.

**SURGERY AT THE NEW YORK HOSPITAL ONE HUNDRED YEARS AGO**, by *Eugene H. Pool and Frank J. McGowan*. Paul B. Hoeber, New York, 1930. Price, \$1.50.

The two oldest hospitals in America are Philadelphia Hospital, founded by Franklin in 1751, and New York Hospital, which was granted a royal charter June 13, 1771, to "The Society of the Hospital in the City of New York in America."

This hospital holds an important place in the history of American medicine. It was not only an institution for the care of the sick but it early became an important teaching center and associated with its faculty were such great names as Wright Post and Valentine Mott, both pioneers in vascular surgery, and David Hossack and Valentine Seaman, prominent in the introduction of vaccination in New York.

Doctor Pool and Doctor McGowan have made an attractive story of the hospital and the great personalities that formed its staff. There are excerpts from the old registers of patients, the old case histories, prescription files, account books, and letter books of the hospital that are full of interesting particulars of the medical and surgical practice of the day. Amputations, cranial injuries, the treatment of fractures, snake bites, tetanus, and the venereal diseases are covered, and the clinical cases cited. The dosages of drugs, bloodletting, the use of gold muriate and sarsaparilla in syphilis, opium in tetanus, all are passed in review. There are some excellent illustrations, rare portraits, facsimiles of prescriptions, case histories, and early pictures of the hospital.

The book is uniform in size and binding with other Hoeber monographs on medical history.

**HYPERTENSION AND NEPHRITIS**, by *Arthur M. Fishberg, M. D., Adjunct Attending Physician to Mount Sinai and Montefiore Hospitals, New York City*. Lea & Febiger, Philadelphia. Price, \$6.50

In a book of about 500 pages the author has brought together the main features of the recent advances in the field of hypertension and nephritis. The book is well written and paragraphed, with a caption to each leading paragraph which compels attention to the sub-

ject matter. Doctor Fishberg commences with the pathological physiology of renal function, tests, and findings, such as casts and albumin. He next discusses edema and its many factors. In considerable detail he discusses hypertension, with the varying types, and the factors concerned in etiology. One interesting chapter is devoted to the discussion of the medical profession's understanding of kidney pathology before, during, and since the work of Richard Bright. There follow several chapters on the types of kidney disease, with the diagnosis and treatment for the varying conditions. Considerable space is given to essential hypertension, with the clinical picture, etiology, treatment, and prognosis. There is a good index. After each of the 26 chapters is a bibliography which gives the student further field for study. The book should prove to be a valuable reference addition to the library.

**TREATMENT IN GENERAL PRACTICE**, by *Harry Beckman, M. D., Professor of Pharmacology at Marquette University, Milwaukee, Wisconsin.* W. B. Saunders Co., Philadelphia. Price, \$10

The author has succeeded in bringing together the methods of treatment of various physicians. The sources are listed in a 31-page bibliography.

The book has a good index and should be useful as a quick reference. There is a short paragraph on the disease and the symptoms preceding each discussion of the treatment.

The book has been written particularly for the needs of the general practitioner.

**THE CREED OF A BIOLOGIST, A BIOLOGIC PHILOSOPHY OF LIFE**, by *Aldred Scott Warthin, Ph. D., M. D., LL. D., Professor of Pathology and Director of the Pathological Laboratories in the University of Michigan, Ann Arbor.* Paul B. Hoeber (Inc.), New York, 1930. Price, \$1.50.

Doctor Warthin has taught medical students for 39 years. He has taught them more than medicine. They have been influenced by his philosophy; his creed as a biologist. As a teacher he has "always been fond of digressing from the beaten paths of pathologic knowledge into those of art, music, philosophy, religion, old books, or what not, seeking thereby to fix some point in the student's mind."

Now he finds that these digressions counted most in his teaching.

Now his students and many others will be glad to have these 60 small pages, printed in the superb style for which the Hoeber books are known, and expressing Doctor Warthin's biologic credo, the philosophy of life which has animated and directed his existence.

**THE ESSENTIALS OF HISTOLOGY**, by *Sir Edward Sharpey Schafer, F. R. S., Professor of physiology in the University of Edinburgh.* Twelfth Edition. Lea & Febiger, Philadelphia, 1929. Price, \$5.

As the first edition of Schafer's Histology appeared in 1885, the book has now been a recognized standard work for nearly a half

century. This twelfth edition was published in September, 1929. Each new edition has been more remarkable in perfection of text and illustrations. To say more would be to gild the lily. As a text and reference for students of histology it remains unexcelled.

**CHILDHOOD TYPE OF TUBERCULOSIS**, by *Henry D. Chadwick and F. Maurice McPhedran*. National Tuberculosis Association, New York City, 1930.

This is the clearest and most concrete treatise thus far compiled on the difficult subject of childhood tuberculosis.

Doctor Chadwick, who planned and inaugurated the 10-year project of searching out all school children in Massachusetts who have childhood type of tuberculosis is author of the section on the Diagnosis, Treatment, and Significance of Childhood Tuberculosis, and Doctor McPhedran, of Phipps Institute, contributed the section on X rays. It consists of: The Diagnosis and Treatment of Childhood Tuberculosis; Classification of the Lesions; Aquatone Reproductions of X-ray Plates with Interpretations; Detailed Instructions for Making the Tuberculin Test; Color Plates of Tuberculin Reactions.

The manual is available through State and local tuberculosis associations or from the National Tuberculosis Association, 370 Seventh Avenue, New York.

**MODERN OTOTOLOGY**, by *Joseph Clarence Keeler, M. D., F. A. C. S., Associate Professor of Otolaryngology, Jefferson Medical College; Otolaryngologist, Germantown Hospital; etc.* F. A. Davis Co., Philadelphia, 1930. Price, \$10.

This is the best-looking work on otology that has come before this reviewer. Although now in its first edition, many more successful editions are predicted for it.

Unfortunately space does not permit any detailed discussion of the merits of this book.

The illustrations are perfect. The text is put together in a fashion that will appeal strongly to those in search of practical information in modern otology.

**THE DISEASES OF INFANCY AND CHILDHOOD**, by *L. Emmett Holt, M. D., Sc. D., LL. D., Formerly Professor of Diseases of Children in the College of Physicians and Surgeons (Columbia University), New York; Physician-in-Chief to the Babies' Hospital, New York, and John Howland, A. M., M. D., Formerly Professor of Pediatrics in the Johns Hopkins University, Baltimore; Director of the Harriet Lane Home; Pediatrician-in-Chief to the Johns Hopkins Hospital.* Ninth edition. D. Appleton & Co., New York, 1929.

This will be the last edition of Holt and Howland's Pediatrics. Both authors have died since the publication of the eighth edition.

Doctor Holt wrote the first edition in 1896. Doctor Howland has been a coauthor in the editions which appeared since 1911.

This latest edition includes extensive changes made by Doctor Howland before his death.

The book has been the standard American work for 30 years and no doubt will remain unexcelled for some years to come.

**THE TREATMENT OF SKIN DISEASES**, by *Noxon Toomey, M. D., B. A., F. A. C. P., Late Instructor in Dermatology, St. Louis University.* The Lister Medical Press, St. Louis, 1930.

This is Volume III of Toomey's Principles and Practice of Dermatology. The first two volumes concern pathology and diagnosis, respectively. They have not been seen by this reviewer.

In 500 pages devoted exclusively to treatment, and written by an acknowledged authority, the book obviously contains a large amount of detailed information.

Unfortunately the publishing job has been very poorly done—cheap paper, poor composing, inferior printing.

**DERMATOLOGY AND SYPHILOLOGY FOR NURSES**, by *John H. Stokes, M. D., Duhring Professor of Dermatology and Syphilology, The School of Medicine, and Professor in the Graduate School of Medicine, University of Pennsylvania, etc.* W. B. Saunders Co., Philadelphia, 1930.

With the progress of education in nursing and in modern nursing practice, it is now obvious that no single text can be adequate for the teaching of nursing practice.

Special books on the special branches of nursing and written by the highest authorities are needed if the nurse is to become something more than a technician, performing a purely mechanical rôle.

For the understanding and recognition and management of cases of syphilis and skin diseases, the nurse can find no better or more useful or handier or authoritative book than this.

It contains 300 pages.

By no means its least important section is Part IV, which deals with the social hygiene, the social and economic background involved in syphilis.

**A TEXTBOOK OF PHYSIOLOGY FOR NURSES**, by *William Gay Christian, M. D., Professor of Anatomy, Medical College of Virginia, and Charles C. Haskell, B. A., M. D., Professor of Physiology and Pharmacology, Medical College of Virginia.* Second edition. The C. V. Mosby Co., St. Louis, 1929. Price, \$2.

An excellent little book for nurses. Clear and simple and adequate, with a skilful portioning of space to the different subjects. The illustrations are splendid—well chosen and very helpful, fitting the text nicely.

**NURSING IN EMERGENCIES**, by *Jacob K. Berman, A. B., M. D., F. A. C. S., Assistant in Surgery Indiana University School of Medicine, Surgical Staffs of Indianapolis City, Methodist, and St. Vincent's Hospitals, etc.* The C. V. Mosby Co., St. Louis, 1929. Price, \$2.25.

A book of some 150 pages containing much sound and practical information on the subject. The illustrations are rather poor.

**PERSONAL HYGIENE FOR NURSES**, by *Seneca Egbert, A. M., M. D., Dr. P. H., Professor of Hygiene, University of Pennsylvania, etc.* F. A. Davis Co., Philadelphia, 1930. Price, \$2.50.

A good little teaching book which brings to nurses much understanding of the principles of public health, and more particularly the principles of personal hygiene.

**ESSENTIALS OF MEDICAL ELECTRICITY**, by *Elkin P. Cumberbatch, M. A., B. M. (Oxon.), D. M. R. E. (Camb.), M. R. C. P., Medical Officer in Charge, Electrical Department, St. Bartholomew's Hospital, etc.* Sixth edition. The C. V. Mosby Co., St. Louis, 1929. Price, \$4.25.

Although this book contains little not already supplied by any one of several other excellent books on the subject, it is a work of exceptional quality and deserves high praise. It may not be a valuable addition to already existing literature, but it is a sound book, possessing every merit and is entitled to a place in the libraries of those who employ electrotherapeutic measures.

**VENEREAL DISEASE, ITS PREVENTION, SYMPTOMS AND TREATMENT**, by *Hugh Wansey Bayly, M. C., Hon. Sec. Society for the Prevention of Venereal Disease, etc.* Fourth edition. F. A. Davis Co., Philadelphia, 1930.

A handy little manual covering well the subjects mentioned in the title, and largely reflecting the opinions and lessons which came to the British medical services from their extensive war experiences.

**NORMAL FACTS IN DIAGNOSIS**, by *M. Coleman Harris, M. D., Lecturer on Physical Diagnosis, New York Homeopathic Medical College and Flower Hospital, etc., and Benjamin Finesilver, M. D., Lecturer on Diseases of the Nervous System, New York Homeopathic Medical College and Flower Hospital, etc.* F. A. Davis Co., Philadelphia, 1930.

Of especial value to students who will find here much aid in gaining a thorough knowledge of normal physical findings, and thus be able to discern better the pathologic signs.

**THE NORMAL DIET, A SIMPLE STATEMENT OF THE FUNDAMENTAL PRINCIPLES OF DIET FOR THE MUTUAL USE OF PHYSICIANS AND PATIENTS**, by *W. D. Sansum, M. S., M. D., F. A. C. P., Director of the Potter Metabolic Clinic, Department of Metabolism, Santa Barbara Cottage Hospital, Santa Barbara, Calif.* Third edition. The C. V. Mosby Co., St. Louis, 1930. Price, \$1.50.

This is an extremely useful little book (134 pages) because it is scrupulously true to its subtitle. It is extremely readable—for patient as well as physician—and is a practical and ready reference of high value.

The diet menus are especially helpful.

**TRAUMA, DISEASE. COMPENSATION, A HANDBOOK OF THEIR MEDICO-LEGAL RELATIONS**, by *A. J. Fraser, M. D., Chief Medical Officer, Workmen's Compensation Board, Winnipeg.* F. A. Davis Co., Philadelphia, 1930. Price, \$6.50.

This concerns principally the legal aspects of disabilities resulting from industrial injuries. It should be especially of value to medical

officers of the Veterans' Bureau or to physicians engaged in industrial medicine.

**SYMPTOMS OF VISCERAL DISEASE**, by *Francis Marion Pottenger, A. M., M. D., LL. D., F. A. C. P., Medical Director, Pottenger Sanatorium for Diseases of the Lungs and Throat, Monrovia, Calif.; Author of "Clinical Tuberculosis," "Tuberculin in Diagnosis and Treatment," etc.* Fourth edition. The C. V. Mosby Co., St. Louis, 1930. Price, \$7.50.

The fact that this book has reached its fourth edition in 10 years attests its value and wide recognition.

It is a study of visceral neurology and presents a neurologic explanation of subjective symptoms of visceral disease.

"The influence of emotions upon the nerves and endocrines is stressed in such a manner as to emphasize the fact that abnormal physiologic action can result as much from psychical stimuli as from physical stimuli."

**GETTING WELL AND STAYING WELL**, by *John Potts, M. D., Fort Worth, Tex.* Second edition. The C. V. Mosby Co., St. Louis, 1930. Price, \$2.

The book is a valuable collection of practical facts compiled by one of long and practical experience in treating tuberculosis.

The book is primarily for lay readers, but it should be very helpful to and should answer many questions for physicians and nurses as well as patients.

As Doctor Potts says, "tuberculosis work is a teaching business"—one will go far to find a better little book to aid in this teaching.

**CLINICAL ATLAS OF BLOOD DISEASES**, by *A. Plancy, M. D., M. R. C. P., Research Pathologist, Cancer Hospital, London Consulting Pathologist, Chelmsford Hospital, and Stanley Wyard, M. D., M. R. C. P., Physician, Bolingbroke Hospital, and Assistant Physician, Cancer Hospital, London.* P. Blakiston's Son & Co. (Inc.), Philadelphia, 1930.

This is a handy little volume of 100 pages, containing just the colored plates and descriptions which makes the book particularly helpful to the student as well as the worker in hematology.

**RESEARCH AND MEDICAL PROGRESS AND OTHER ADDRESSES**, by *J. Shelton Horsley, M. D., Attending Surgeon, St. Elizabeth's Hospital, Richmond, Va.* The C. V. Mosby Co., St. Louis, 1929. Price, \$2.

A collection of addresses delivered by the author before various medical societies. These deal with surgery, with medical ethics and with the practice of medicine in Virginia.

**RECENT ADVANCES IN PREVENTIVE MEDICINE**, by *J. F. C. Haslam, M. C., M. D. (Edin.), M. R. C. P. (Edin.), D. P. H., Assistant Director, Bureau of Hygiene and Tropical Diseases; Director of Library Services, London School of Hygiene and Tropical Medicine; formerly Government Medical Officer of Health, British Guiana*, with a chapter on the vitamins, by *S. J. Cowell, M. A., M. B., M. R. C. P., Professor of Dietetics in the University of London*. P. Blakiston's Son & Co. (Inc.), Philadelphia, 1930.

This is uniform with the Recent Advances Series consisting of 16 books on as many different branches of medicine, published by P. Blakiston's Son & Co. (Inc.).

Of especial interest is the chapter on Recent Advances in our Knowledge of Vitamins, contributed by S. J. Cowell, professor of dietetics in the University of London.

**ROENTGENOGRAPHIC TECHNIQUE, A MANUAL FOR PHYSICIANS, STUDENTS, AND TECHNICIANS**, by *Darmon Artelle Rhinehart, A. M., M. D., Professor of Roentgenology and Applied Anatomy, School of Medicine, University of Arkansas*. Lea and Febiger, Philadelphia, 1930. Price, \$5.50.

A well compiled and well written book, of great practical value, but containing no particular contributions or features not included in a number of other equally good books on the subject published during the last two years.

**DEMONSTRATIONS OF PHYSICAL SIGNS IN CLINICAL SURGERY**, by *Hamilton Bailey, F. R. C. S. (Eng.), Surgeon, Dudley Road Hospital, Birmingham; late Honorary Assistant Surgeon, Surgical Registrar and Tutor, Liverpool Royal Infirmary; Surgical Registrar and First Surgical Assistant, London Hospital, etc.* Second Edition. William Wood & Co., New York, 1930. Price \$6.50.

A useful little book on surgical diagnosis designed for medical students, but it should be of considerable assistance to all general practitioners. The illustrations are numerous and excellent.





# THE DIVISION OF PREVENTIVE MEDICINE

Capt. M. A. STUART, Medical Corps, United States Navy, in charge

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NOTES ON PREVENTIVE MEDICINE FOR MEDICAL OFFICERS, UNITED STATES NAVY

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## TOXIC EFFECTS OF ARSENICAL COMPOUNDS EMPLOYED IN THE TREATMENT OF SYPHILIS IN THE UNITED STATES NAVY

### A STATISTICAL STUDY OF THE RESULTS OF 272,354 INJECTED DOSES OF NEOARSPHENAMINE AND OTHER COMPOUNDS OF ARSENIC

By J. R. PHELPS, Commander, Medical Corps, United States Navy, and W. A. WASHBURN, Chief Pharmacist's Mate, United States Navy

Since November, 1924, medical officers of the Navy have been required to report monthly the numbers of doses of arsphenamine, neoarsphenamine, etc. administered. A separate account of every case in which ill effects are noted is required.

Previous articles dealing with the information obtained from these reports were published in the September, 1925, January, 1927, and January, 1929 numbers of the BULLETIN. The present article takes into consideration all doses of arsenical compounds administered in the Navy in the treatment of syphilis during the calendar years 1925, 1926, 1927, and 1928—a total of 272,354 doses. All but a few of the doses were injected intravenously. Deaths occurring since January 1, 1919, from the administration of arsenical compounds are considered.

We are concerned here only with the damage which may result from the administration of these drugs, not with their therapeutic value in the treatment of disease or with indications for their employment in the treatment of syphilis.

In February, 1925, having in mind such information as had been published up to that time regarding the toxic effects of arsenical compounds, including the very useful 1922 report of the Salvarsan Committee of the British Medical Research Council, we concluded it was best for the time being not to attempt much in the way of classification, because the records of cases available for study and comparison were few in number. Since then we have been engaged in collecting and assembling such information as reports of medical officers of the United States Navy have afforded. We must now

classify the observed facts more or less in order to review them. In doing this we will avoid as much as possible ill-defined terms and terms of restricted meaning such as "nitritoid crisis," "anaphylactoid reaction," etc., although it is necessary to refer to them.

In 1925, when this study was begun, it seemed that deaths following the administration of arsphenamine or neoarsphenamine might well be grouped as:

(a) Cases in which death followed within a few hours after the injection of a therapeutic dose.

(b) Cases in which death followed in from a few hours to a few days.

(c) Cases in which death was delayed for many days or weeks but nevertheless was probably the result of treatment rather than syphilis. To-day it is apparent that the time factor is of secondary importance in classifying cases.

Very early in the study we recognized the importance of non-fatal manifestations presumably due to toxic action of the drug. We fell into the habit of using the term, "severe reaction," to cover such manifestations, but as a matter of fact that term does not fit very well except in cases where symptoms obviously resulting from administration of the drug appear immediately or within a few hours after an injection.

The following is a general summary of case reports describing manifestations attributed to toxic action of the various arsenical compounds administered in the treatment of syphilis among naval personnel from January 1, 1925, to December 31, 1928:

TABLE 1.—Fatal and nonfatal toxic effects of arsenical compounds administered in the United States Navy, 1925-1928

Drug	Total number doses administered	Mild symptoms regarded as toxic effects	Severe but not alarming manifestations	Alarming but not fatal manifestations	Deaths attributed to the drug	Ratio of deaths to doses administered
Arsphenamine.....	22,625	Cases 15	Cases 4	Cases 8	1	1 to 22,625.
Neoarsphenamine.....	237,599	94	48	38	16	1 to 14,844.
Sulpharsphenamine.....	5,197	1	2			
Tryparsamid.....	6,933	1				
Total.....	272,354	111	54	46	17	1 to 16,021.

*Deaths from neoarsphenamine, 1925-28.*—The figures for neoarsphenamine are of particular interest because that is the compound which has been used principally in the Navy in recent years. One death resulted from the administration of arsphenamine in 1927, the only death from that compound since 1924. The case was one of acute hemorrhagic encephalitis.

Deaths attributable to neoarsphenamine occurred during the 4-year period, 1925-28, in ratio to doses administered, as follows:

TABLE 2.—Deaths from neoarsphenamine, 1925-1928

Year	Number of doses of neoarsphenamine administered	Deaths	Ratio
1925.....	41, 791	2	1 to 20,895.
1926.....	55, 652	4	1 to 13,913.
1927.....	68, 422	4	1 to 17,105.
1928.....	71, 816	6	1 to 11,969.

Deaths charged to the administration of arsenical compounds in the treatment of syphilis during the past 10 years.—Mortality records are available for the calendar year 1919 and for subsequent years. Deaths were recorded as follows:

TABLE 3

Year	Arsphenamine	Neoarsphenamine	Kind not specified	Total
1919.....	2	0	1	3
1920.....	1	1	0	2
1921.....	3	1	0	4
1922.....	0	4	0	4
1923.....	0	1	0	1
1924.....	1	2	0	3
1925.....	0	2	0	2
1926.....	0	4	0	4
1927.....	1	4	0	5
1928.....	0	6	0	6
Total.....	8	25	1	34

No data are available for one of the patients who died in 1919 and consequently it is not known whether arsphenamine or neoarsphenamine was administered in that case. The other 33 cases may be listed as follows:

TABLE 4

Immediate cause of death	Arsphenamine	Neoarsphenamine
Acute hemorrhagic encephalitis.....	5	15
Vasomotor phenomena:		
Immediate shock—		
1921: Death in 90 minutes.....	1	0
1924: Death in 60 minutes.....	0	1
1923: Death in 40 minutes.....	0	1
Delayed shock—		
1920: Death in 12 hours.....	0	1
Thrombosis of right ventricle and pulmonary artery—		
1919: Sudden death 45 hours after second dose.....	1	0

<sup>1</sup> Arsphenamine accidentally injected without neutralizing, under the impression that it was neoarsphenamine.

TABLE 4—Continued

Immediate cause of death	Arsphen-amine	Neocarsphenamine
Acute arsenical poisoning; hemorrhage into stomach and intestines—		
1927: Death 31 hours after 0.4 gram dose.....	0	1
Acute arsenical poisoning; transverse myelitis (bulbar)—		
1924: Three doses, neocarsphenamine, amounts not stated, given in one week.....	0	1
Acute arsenical poisoning (and possibly acute mercurial poisoning); embolism, anterior tibial artery; edema of the lungs—		
1922: No other data available.....	0	1
Purpura hemorrhagica—		
1921: Hemorrhages began a few hours after second dose; death on the fifteenth day.....	1	0
Dermatitis exfoliativa—		
1927: Death 30 days after third dose.....	0	1
1928: Death 21 days after sixth dose.....	0	1
1928: Death 28 days after ninth dose.....	0	1
1928: Death 40 days after eighth dose; multiple abscesses of the lungs.....	0	1
Total.....	8	25

The Salvarsan Committee of the British Medical Research Council in its 1922 report stated that the most important ill effects of treatment with arsenobenzol preparations which may end fatally are: (a) Encephalitis hemorrhagica; (b) acute yellow atrophy of the liver; (c) exfoliative dermatitis and its complications.

There would remain then certain manifestations occurring in a small proportion of cases treated, which the committee contemplated under the heading of vasomotor phenomena, and certain other ill effects of the drug which would be met with very rarely indeed, such as acute renal damage, ulcerative enteritis, polyneuritis, and aplastic anemia.

#### HEMORRHAGIC ENCEPHALITIS

As indicated in Table 4, there have been 20 deaths from this cause since 1918. Besides these fatal cases there has been one terminating in recovery in which the condition undoubtedly existed. There were typical manifestations, including coma and repeated convulsions.

The patient, a young man 22 years old, with lesions of secondary syphilis, had a convulsion and became comatose 66 hours after the second of two 0.9-gram doses of neocarsphenamine given one week apart. In the course of four days following his first convulsion he was given seven intravenous injections of sodium thiosulphate, consisting in all of 10.5 grams. The case was described in detail in our last article on this subject which appeared in the January, 1929, number of the BULLETIN.

Including this typical nonfatal case we have 21 for study.

*Dosage in neocarsphenamine cases.*—Hemorrhagic encephalitis developed after indicated doses, as follows:

	Cases
First dose, 0.45 gram.....	1
Second dose, 0.45, 0.6, seven days apart.....	3

	Cases
Second dose, 0.5, 0.8, seven days apart-----	1
Second dose, 0.3, 0.9, seven days apart-----	1
Second dose, 0.45, 0.9, interval not recorded-----	1
Second dose, 0.9, 0.9, seven days apart-----	3
Second dose, 0.9, 0.9, thirteen days apart-----	1
Third dose, 0.45, 0.6, 0.9, intervals four days and seven days-----	1
Third dose, 0.45, 0.6, 0.9, seven days apart-----	1
Fifth dose, 0.6, 0.4, 0.4, 0.6, and 0.75, five to seven days apart with interval of two weeks between third and fourth doses-----	1
Eighth dose, 0.6, 0.6, 0.6, 0.8, 0.9, 0.8, 0.9, and 0.6; first six doses seven days apart; then an interval of 38 days after which the last two doses were injected seven days apart-----	1
Eighth dose, size of last and preceding doses not recorded-----	1
<b>Total-----</b>	<b>16</b>

*Symptoms.*—No details are known about one of the cases. In all but 5 of the 21 cases for which we have data, repeated convulsions occurred and coma preceded death for from an hour or two to many hours in the fatal cases. Two patients became comatose and died without a convulsion. Another had high fever and delirium and died 72 hours after his second dose of neoarsphenamine consisting of 0.8 gram. Shortly before death his temperature was 106° F. Twelve hours after the intravenous injection the posterior cervical lymph glands became enlarged and tender. Post-mortem findings established the diagnosis—congestion of the meninges, edema of the brain, and serofibrinous exudate with punctate hemorrhages.

In another case in which symptoms referable to the brain were not conspicuous the patient had a temperature of 103° F. a few hours after his second dose of arsphenamine, 0.6 gram. The first dose, 0.3 gram, had been given one week before. The history indicated that the man had contracted syphilis in 1914. Treatment was begun in 1927 with the two doses mentioned, because of mental symptoms suggestive of beginning paresis. The blood Wassermann test was 1 plus. Twenty-four hours after the 0.6-gram dose his temperature was 99.5° F., but it rose to 103° F. that evening. The next day there was an erythematous rash on the chest and abdomen. The rash became more pronounced in a few hours. The patient was weak in his legs, vomited, and presented symptoms and signs of shock. He was mentally clear. A few hours later dyspnea supervened and his pulse became rapid and imperceptible. He died 60 hours after the intravenous injection of arsphenamine. Post-mortem examination disclosed intense congestion of the cerebral meninges with serofibrinous exudate. The abdominal viscera and the thoracic and abdominal organs appeared to be normal.

This was a case of acute fatal poisoning by a comparatively small amount of arsphenamine. Because of the autopsy findings we have

included it with the encephalitis cases. Such cases suggest that there is no basic difference between hemorrhagic encephalitis resulting from the intravenous administration of an arsenical compound and so-called vasomotor phenomena, ranging from the immediate shock-like or anaphylactoid reactions to those in which vasomotor disturbances do not become manifest for 24 hours or more. In any case, the term "acute poisoning by arsenic" is descriptive.

In another case without convulsions, where 0.9 gram of neoarsphenamine was given intravenously one week after a first dose of 0.45 gram, the patient reported 72 hours after the second dose on account of headache. His temperature was 100.2° F. Five hours later he became delirious and cyanotic, and, shortly after that, comatose. His temperature rose to 104.4° F. He died 80 hours after the injection. His brain was not examined. The patient was in the early secondary stage of syphilis.

One case in this series of 20 deaths charged to hemorrhagic encephalitis was unusual in that death followed a single dose of only 0.45 gram of neoarsphenamine. The dose was given intravenously 10 days after the appearance of a small lesion on the penis in the case of a young man. The lesion may or may not have been syphilitic. About 48 hours after the injection the patient complained of headache, dizziness, and extreme nausea. There was persistent vomiting. He had no pain or discomfort in the region of the stomach except during attacks of nausea. Five days after these symptoms began the patient became stuporous. His speech was blurred. There was noticeable spastic paraplegia. The knee jerks and pupillary reflexes were absent. There was retention of urine and constipation. There was a large trace of albumin in the urine. Stupor increased and the patient had difficulty in swallowing. He passed into a state of deep coma and died 294 hours after the dose of neoarsphenamine. Post-mortem examination disclosed congestion of the brain and serofibrinous exudate in the walls of the ventricles and about the choroid plexus. Microscopic examination of a section through the pontile nuclei revealed a marked hemorrhagic condition of the tissue, blood having escaped from the vessels and penetrated into surrounding tissue to a considerable extent. In many of the vessels there were leukocytic thrombi. In others mononuclear cells had infiltrated their sheaths. There was little indication of any reaction on the part of surrounding tissue. The lesions were diffuse but largely located in the gray matter.

In this case the small amount of neoarsphenamine injected probably explains the unusual duration of life after the introduction of the arsenical compound. In most of the cases of arsenical hemorrhagic encephalitis death occurs in from 60 to 96 hours after injection of the last dose.

So far as can be judged from the reports, in 4 of the 21 cases of hemorrhagic encephalitis under review, the first indication of toxic action was a convulsion. In these the first convulsion occurred 24, 48, 55, and 72 hours, respectively, after the last injection of the arsenical compound. It is possible that premonitory symptoms developed in these cases, but if so they were not recorded.

In 8 of the 21 cases there was a definite febrile reaction before symptoms definitely referable to the central nervous system appeared. In four of these, elevation of temperature was noted a few hours after the intravenous injection, ranging from 100° F. to 106° F. In the other four febrile cases there was a delay of 12 to 72 hours before rise of temperature was noted and then a range of from 100° to 106° F. was recorded. Along with fever the following symptoms were noted but no one patient had all of them: Headache, prostration, backache, severe abdominal pain, vomiting, diarrhea, rapid pulse, nervousness, restlessness, congestion of the throat and eyes, swelling of the posterior cervical glands, delirium, cyanosis and slight twitchings of muscles.

In two cases vomiting and diarrhea occurred without fever. One of these was the case described above in which death from hemorrhagic encephalitis occurred 294 hours after a single dose of 0.45 gram of neoarsphenamine.

In four cases without fever the following manifestations preceded the occurrence of repeated convulsions and coma: Great muscular weakness, pain in the back and hips, muscular twitchings, dizziness, drowsiness, peculiar feeling.

*Duration of life after the dose precipitating hemorrhagic encephalitis.*—In the 20 fatal cases of acute hemorrhagic encephalitis here reviewed, the intervals from the intravenous injection of the final dose of the arsenical compound to the time of death were as follows: 43, 43, 54, 55, 60, 64, 70, 72, 78, 80, 80, 80, 80, 84, 87, 92, 92, 136, 144, and 294 hours.

*Cases suggesting borderline relationship between acute hemorrhagic encephalitis and the other forms of acute poisoning by arsenical compounds used in the treatment of syphilis.*—Six nonfatal cases may be mentioned here as having had some of the manifestations noted in proved fatal cases of hemorrhagic encephalitis. Two patients who did not appear very ill had twitchings of muscles all over the body. These patients also complained of "tingling" in the hands and feet. Another patient who did not have syphilis but was given 0.6 gram of neoarsphenamine intravenously for Vincent's angina, followed by 0.7 gram six days later, began to feel shaky about 17 hours after the second dose. He then complained of hypersensitiveness of the skin. Coarse tremors of the hands were noted and also twitchings of muscles, especially of the face. There

was great muscular weakness and noticeable psychomotor retardation. His pupils were dilated. These symptoms disappeared in about two days with no special treatment.

A patient who had contracted syphilis about seven years before and had been given many injections of arsphenamine and neoarsphenamine, as well as much mercury, after a rest period of several months, was given 0.6 gram of neoarsphenamine intravenously. One hour after the injection he had violent pains in the abdomen, arms and legs. He also vomited and kept on vomiting, bringing up nothing but a little bile each time. He was given 1 cubic centimeters of adrenalin solution and 0.01 grain of atropin subcutaneously. The symptoms disappeared in about half an hour. The case was classed as one of immediate vasomotor phenomena.

A young man in the secondary stage of syphilis was given two intravenous injections of neoarsphenamine seven days apart. About twenty-four hours after the second dose he had a chill, vomited frequently, and became greatly prostrated. Twelve hours later he was hurriedly removed to hospital in a state of collapse. His temperature was 95° F., and his pulse, rapid and weak. His face was congested and his eyes protruded. He was clouded mentally and was disoriented. There was retention of urine. Sodium thiosulphate was administered once daily for three days. Five days after admission to hospital he appeared to have recovered entirely.

A patient who was considered as having had sufficient treatment for syphilis about a year before was given 0.45 gram of neoarsphenamine as a provocative dose after several negative Kahn tests. Ten hours after that dose he had a chill, followed by severe headache and a temperature of 103° F. The face was flushed and the conjunctivæ injected. His fever lasted for two days, but headache continued after that, and there was considerable mental disturbance, including wandering speech. It may be mentioned that the blood Kahn test made after the provocation injection was reported as negative.

*Proportion of deaths from hemorrhagic encephalitis to numbers of patients treated for syphilis and to numbers of doses of arsenical compounds administered.*—During the 4-year period, 1925–1928, the average number of patients treated for syphilis in the Navy per annum was 3,220. During that period the average number of deaths per annum from arsenical hemorrhagic encephalitis was 2.75. The compounds responsible for these deaths were arsphenamine and neoarsphenamine. For both together the ratio was 1 death for every 1,171 patients treated. Available data do not permit patients treated with neoarsphenamine to be separated from those treated only with arsphenamine, if there were any such patients.

With respect to numbers of doses of the drugs administered during this period, there were 22,625 intravenous injections of arsphenamine



with 1 death. There were 237,599 intravenous injections of neoarsphenamine during the same period, resulting in 10 deaths from hemorrhagic encephalitis, giving a ratio of 1 death to 23,760 doses administered. In this particular respect, therefore, there seems to have been little difference between the action of arsphenamine and neoarsphenamine.

During this period of four years 5,197 doses of sulpharsphenamine and 6,933 doses of tryparsamid were administered, with no deaths from any cause referable to the arsenical compound.

In view of the preponderant use of neoarsphenamine ratios by years are of interest. They are as follows:

TABLE 5

Year	Number of doses of neoarsphenamine administered	Deaths from hemorrhagic encephalitis	Ratio
1925.....	41, 791	2	1 to 20, 896.
1926.....	55, 652	4	1 to 13, 913.
1927.....	68, 381	2	1 to 34, 190.
1928.....	71, 816	2	1 to 35, 908.

It is also of interest to note the incidence of hemorrhagic encephalitis in proportion to the numbers of injected doses of neoarsphenamine lots supplied the Navy by various manufacturers. The different manufacturers are represented by letters, and each manufacturer is designated by the same letter wherever referred to in this article.

TABLE 6

Manufacturer	Number of doses of neoarsphenamine administered	Number of cases of hemorrhagic encephalitis	Ratio
A.....	34, 119	1	1 to 34, 119.
B.....	154, 809	8	1 to 19, 351.
C.....	11, 201	1	1 to 11, 201.
D.....	33, 028	0	
E.....	1, 597	0	

In two fatal cases of hemorrhagic encephalitis the condition was not recognized by the medical officers treating the patients. In one case the diagnosis was established at the United States Naval Medical School after examination of the brain, and in the other case by a review of the evidence by Capt. M. A. Stuart, Medical Corps, United States Navy, in charge of the Division of Preventive Medicine. The lot number and make of neoarsphenamine was not recorded in either of these cases.

Besides the doses of neoarsphenamine indicated in the above table, neoarsphenamine of four other makes was used in the Navy during the 4-year period to a total of 2,814 doses. No case of hemorrhagic encephalitis resulted from the use of any of those lots.

#### VASOMOTOR PHENOMENA

Toxic effects of arsenical compounds employed in the treatment of syphilis which would be considered under this heading would include shock-like reactions of all degrees, appearing immediately after injection or after a delay of many hours, manifestations described by French writers under the term, "nitritoid crisis," and phenomena described by writers in the United States and abroad as anaphylactoid reactions.

The Salvarsan Committee of the British Medical Research Council, referred to above, contemplated all such manifestations and disturbances under the heading of vasomotor phenomena. To us this seems the most satisfactory way of classifying such cases as have occurred in the United States Navy.

We have in mind, however, the comprehensive address entitled, "The Basis of Allergic Phenomena," presented by Professor Hanzlik of Stanford University to the American Medical Association at Chicago in 1924. In many of the cases observed in the Navy, with manifestations ranging from trivial and transient disturbances of the circulation to appearances of sudden and alarming shock, the conditions conformed to the "characteristics of anaphylactoid phenomena" as described and discussed by Hanzlik. He contemplated as synonymous with this group: Nitritoid crises, idiosyncrasies, hemoclasis, colloidoclasia, responses to foreign protein, nonprotein reaction, colloid disturbances, irritant effects, protoplasmic activation, proteoclastic action, autohemotherapy, hemotherapy, osmotherapy, atopy, and allergy.

He pointed out that a variety of agents unrelated physically and chemically are effective in producing the phenomena, native or simple proteins not being required. He listed the following as having been reported or demonstrated to be effective, especially when injected intravenously:

Nonnitrogenous colloids (agar, tragacanth, pectin, gelose, starch, acacia).  
Colloidal metals (iron, collargol, arsenous sulphide, mercuric oxide and sulphide, colloidal gold).

Tissue extracts.

Nitrogenous colloids and mixtures—plant juices and proteins, peptones, proteoses, pancreatin, milk, casein, and others.

Vaccines (bacteria, trypanosomes, tuberculin, typhoid vaccine, and others).

Arsphenamine, neoarsphenamine, etc.

Coal tar, derivatives (paraphenyl-diamin, antipyrin).

Histamin.

Salts of heavy metals (copper sulphate, antimony, and potassium tartrate).

Adsorbents—kaolin, charcoal, India ink, fuller's earth, barium sulphate, and others.

Salts—iodides, bromides, nucleates, citrates, oxalates, protalbinat.

Hypertonic solutions—10 per cent sodium chloride, 50 per cent glucose, 50 per cent sucrose, 40 per cent hexamethylenamin.

Tannin.

Glacial acetic acid.

Congo red.

Copalba.

Gentian violet.

Camphor oil.

Ricin.

Tincture of iodine.

Iodoform.

Alkaloids (quinin, emetin).

Acetylsalicylic acid.

Hanzlik notes that calcium salts do not cause anaphylactoid phenomena in guinea pigs but, on the other hand, prevent or inhibit allergic phenomena, presumably by lessening cellular permeability, and he considers that this indicates indirectly the possible physical basis for the reactions produced by many agents. Such phenomena occur chiefly but not exclusively after intravenous injection—intraperitoneal and hypodermic injections also being effective, but less intensively and much more slowly. Sensitization or preliminary injection is not required. The effects occur immediately or rapidly after injection, if at all. The symptom complex is similar to and almost indistinguishable from that of anaphylactic shock in guinea pigs, and with certain agents (histamin and peptone) is similar to that in cats and dogs.

Death in animals receiving intravenous injections is due to circulatory collapse and paralysis of the respiratory center from asphyxia. Asphyxia results from bronchial and alveolar compression with impaired ventilation. This is due in turn to blocking of the pulmonary capillaries by stasis, emboli, thrombi, endothelial adsorption of agglutinated masses, peribronchial and perivascular edemas, hemorrhages, etc. There may also be capillary blockage in other organs, especially the liver and brain.

Toxic substances resulting from the injection of various agents causing anaphylactoid phenomena are not demonstrable. Many of the agents provoking the reactions are themselves relatively inert chemically and pharmacologically, except when administered parenterally, especially intravenously. Hanzlik considered that the evidence as a whole indicates that the basis of both anaphylactic and

anaphylactoid phenomena, collectively the allergic phenomena, is a disturbance in the physical and chemical (colloidal) mechanisms of the blood and tissues.

We have been guided to a considerable extent by these ideas in grouping under the heading of vasomotor phenomena certain cases observed by medical officers of the Navy after injections of arsphenamine and neoarsphenamine.

In most instances, if not all, the manifestations might perhaps just as well be described in more general terms as acute poisoning by arsenic, for arsenic when swallowed in its inorganic compounds sometimes kills in two or three hours, producing manifestations and tissue changes not unlike those observed when death follows soon after an intravenous dose of neoarsphenamine.

Altogether during the 4-year period, 1925-1928, 78 cases were reported by medical officers of the Navy which we, rightly or wrongly, have grouped as examples of vasomotor phenomena following the intravenous injection of neoarsphenamine or other arsenical compound.

*Deaths.*—In 1920 a patient died 12 hours after his third injection of neoarsphenamine. The doses were 0.3 gram followed by 0.6 gram a week later and 0.75 gram 10 days after the second. Two hours after the third dose there was a moderate febrile reaction—101° F. Eight hours later the pulse was rapid and the patient restless. Within an hour dyspnea supervened and death occurred about an hour after that.

In 1921 a patient was accidentally given 0.6 gram of arsphenamine, unneutralized, by the intravenous route. A vasomotor reaction began almost immediately, as is to be expected in such instances, and the patient died in a state of profound shock 90 minutes after the injection.

In 1924 a patient who had contracted syphilis in 1921 and had had several injections of arsphenamine and neoarsphenamine thereafter, was given an injection of 0.9 gram of neoarsphenamine after an interval of many months. He had no reaction. Two weeks later he was given another injection of 0.9 gram of neoarsphenamine—lot number verified. In a few minutes he began to vomit and had a loose bowel movement. Almost immediately he passed into a state of shock. His skin was cold and covered with clammy perspiration, and his pupils were dilated. His pulse was rapid and thready. He died about 60 minutes after the injection. His health record indicated that he had had a severe reaction of some sort after a dose of neoarsphenamine in 1922. Post-mortem findings were engorgement and edema of the lungs; intense congestion of the stomach and duodenum with submucous petechial hemorrhages, and edema and

congestion of the brain with increased intracranial pressure. Petechial hemorrhages were also noted in the endocardium.

In 1927 there was a death, classed in Table 4 as acute poisoning by arsenic. The patient who was in the secondary stage of syphilis, was given 0.45 gram of neoarsphenamine; 0.3 gram three days later; and 0.4 gram four days after that. Two and one-half hours after the last dose he had a scarlatiniform rash on his body. His throat felt sore and his temperature was slightly elevated, 99.6° F. He was given three intravenous injections of sodium thiosulphate, 1.0 gram each during the next 10 hours. His temperature was then 103° F. and pulse, 130. He vomited blood several times and passed about 3 ounces of blood by rectum. Twenty-four hours after the injection of neoarsphenamine he was given another 1.0 gram dose of sodium thiosulphate intravenously, and another three hours after that. He was then very restless and in a state of collapse with rapid, feeble pulse and rapid respiration. Measures to combat shock were employed without effect and the patient died 31 hours after the last dose of neoarsphenamine. Post-mortem examination revealed congestion of the stomach and intestines with hemorrhagic spots. The lungs were congested but the brain appeared normal. The liver was pale.

In 1928 another immediate fatal reaction occurred. The patient, a man 38 years of age, having a strongly positive Kahn test, was given as his first course of treatment a series of six intravenous doses of neoarsphenamine at intervals of seven days, except for an interval of two weeks between the third and fourth doses. The first dose was 0.25 gram; the others were 0.9 gram each. Three or four minutes after the sixth dose was injected he began to cough and expectorate white frothy fluid. Almost immediately he became cyanotic. One gram of sodium thiosulphate was given intravenously at once. Adrenalin solution and atropin were also injected. These measures were without avail. Cyanosis increased rapidly. The pulse felt normal but the heart sounds could not be heard on account of coarse bubbling râles and great dyspnea. He died suddenly 40 minutes after the injection of neoarsphenamine. At autopsy the brain was found congested and purple in color. There was marked edema of the meninges as well as of the cortex, but no petechial hemorrhages were found. The lungs were edematous. The heart showed petechial hemorrhages beneath the endocardium. An effect upon smooth muscle fibers was indicated by the fact that he asked for a bedpan 10 minutes before he died. The stomach and intestines were not remarkable in appearance. The liver, kidneys, and spleen were somewhat congested.

The two deaths, classed under vasomotor phenomena, which have occurred during the 4-year period, 1925-1928, give a ratio of 1 death

to 6,440 patients treated. This is obtained by dividing the yearly average number of syphilitic patients treated by the yearly average number of deaths from this cause during the period. We do not know the actual number of different individuals treated for syphilis. Every year a number of men are treated who began treatment several years before and these are not necessarily readmitted to the sick list, but the figures used make allowance for carry-over cases and are approximately correct. We know the total numbers of doses of the several arsenical compounds administered during the 4-year period. For neoarsphenamine there was 1 death (vasomotor phenomena) to 118,799 intravenous doses, and for arsphenamine no death from 22,625 doses. As mentioned above, one death was caused in 1921 by arsphenamine through the accidental injection of an unneutralized solution of 0.6 gram. That death should hardly be considered in making a comparison with neoarsphenamine. The mistaking of arsphenamine for neoarsphenamine occurred on board ship. In passing it is of interest to mention that a similar mistake was made on board another ship in 1921 when 0.6 gram of arsphenamine was injected intravenously without neutralizing the solution. A severe reaction of the anaphylactoid type developed almost immediately but the patient recovered in a few hours. So far as known those are the only two instances in which arsphenamine has been mistaken for neoarsphenamine in the Navy. No accident of that nature has occurred in recent years.

NONFATAL CASES OF ARSPHENAMINE AND NEOARSPHENAMINE POISONING CLASSED  
AS VASOMOTOR PHENOMENA

*Febrile cases, neoarsphenamine.*—There were 31 cases following intravenous injections of neoarsphenamine in which elevation of temperature developing in from a few minutes to several hours, was a prominent symptom. It is not at all certain that all of these can properly be regarded as instances of vasomotor disturbance, but inasmuch as signs and symptoms of shock appeared in 9 of the 31 cases it is obviously difficult to draw a line of distinction between apparently simple febrile reactions and those in which there are also symptoms especially indicative of anaphylactoid phenomena. In ten cases elevation of temperature was the first symptom. In six, the first symptom was a chill.

In one case, following the administration of 0.6 gram of neoarsphenamine, third dose, the patient experienced severe pains in the joints of arms and legs about three hours after the injection. Three hours after that he was in a state of shock, too weak to rise. He complained of numbness and tingling in his fingers and toes. At that time his temperature was 104° F. He had fever for three days and recovered entirely in four days.

In another case, 10 minutes after the fourth consecutive 0.9 gram dose of neoarsphenamine, there was nausea and vomiting, and the face was hot and flushed. The patient's temperature had already risen to 105° F. One hour later he had rheumatic pains in several joints and he began to have diarrhea. Acute symptoms subsided in eighteen hours but the urine contained a large amount of albumin and a trace of albumin persisted for about a week.

Similar reactions have been observed in certain cases where many injections of an arsenical compound had been taken by the patient previously without impressive untoward effects. For example, a man who contracted syphilis in December, 1925, received 8 injections of neoarsphenamine in the early part of 1926, and 11 injections in the autumn of 1927. In December, 1927, after a rest period of one month, a third course was given with injections at weekly intervals as follows: 0.25, 0.6, 0.9, 0.9, 0.6 gram. Immediately after the last injection the patient's body became flushed and his face cyanotic. He began to vomit and had a feeling of suffocation. His pulse was rapid and weak. Adrenalin chlorid solution was injected hypodermically at once and other measures to combat shock were instituted. The symptoms in this case were somewhat similar to those in the case of the man who died, in 1928, 40 minutes after his sixth injection, consisting of 0.9 gram of neoarsphenamine. That case is described above as a death under the heading "Vasomotor phenomena." In the case under consideration here it was recalled that the patient had had sneezing, coughing, and nausea after most of his previous doses.

A man who contracted syphilis in 1922 and who had taken 32 injections of arsenical compounds in the course of five years, was given 0.3 gram of neoarsphenamine in May, 1928. He had had no arsenical treatment for more than a year. According to the medical officer's report, the result of this small dose was an "immediate anaphylactic shock" of moderate severity. Following the shocklike manifestations the patient's temperature rose to 103° F. and remained elevated for 72 hours. The day after the reaction a moderate degree of jaundice was noted. That lasted for 10 days. About six weeks later the patient was tried with another 0.3 gram dose with a similar result. After that experience treatment was limited to mercury.

The following case is similar in some respects. The man contracted syphilis in February, 1924, but the presence of the disease was not recognized until April, 1926. He was then given 8 injections of an arsenical compound and 40 inunctions of mercury. Apparently he took no more treatment until July 30, 1928, when he was given 0.3 gram of neoarsphenamine. Shortly afterwards he had a chill, and following that, intense erythema was noted. His temperature rose to 104° F. and he had a sense of constriction in his

larynx and a feeling of suffocation. Upon the development of these symptoms sodium thiosulphate, 2 grams, was given intravenously and four hours later 1 gram was injected. One gram was also given by mouth twice daily after that. The patient appeared to have recovered completely in four days. Four months later he was tried with 0.1 gram of neoarsphenamine and he had a similar but less severe reaction.

A man whose health record showed he had been given 105 mercurial inunctions and an unknown number of injections of arsenical compounds, extending over a period of about a year, was given 0.45-gram of neoarsphenamine and a week later 0.9 gram. He had an immediate reaction after the latter dose, beginning with a chill, after which his temperature rose to 104° F. with severe prostration which lasted for about eight hours.

We are unable to discriminate between cases in which vasomotor disturbances are apparent a few minutes after the injection and those in which there is a delay for several hours.

A man who contracted syphilis in 1928 began treatment the following month with an intravenous injection of neoarsphenamine every third day—0.3, 0.6, and 0.6 gram. About seven hours after the third dose he became dizzy and weak in his legs and noticed that his vision was blurred. He vomited. His temperature was found to be 103° F. The extremities were cold and cyanotic. His pulse was recorded as "sluggish," whatever that may mean. Two intravenous injections of sodium thiosulphate, 1 gram each, were given. The patient appeared to have recovered completely in three days. Concurrently with the three injections of neoarsphenamine this patient was given 1 gram of mercurial ointment daily in inunction, potassium iodid by mouth, and potassium bismuth tartrate, 1.5 grains intramuscularly, once a day. Three weeks after this episode the patient was given 0.15 gram of neoarsphenamine and he had what was described as a slight reaction. He was then regarded as intolerant of neoarsphenamine.

In 1927 a reaction of an alarming type occurred, but we were unable to secure desired details of the previous history of the patient. In June and July of that year he was given neoarsphenamine at weekly intervals as follows: 0.45, 0.9, 0.9, and 0.9 gram intravenously. Six hours after the last injection he showed signs of collapse. His temperature at the time was 104° F. Measures to combat shock were employed, including subcutaneous injection of normal salt solution. An unstated amount of sodium thiosulphate was given intravenously. The patient was prostrated for several days and was not regarded as fit for duty until the seventeenth day after the last dose of neoarsphenamine.



Another patient in 1927 was severely affected by two small doses of neoarsphenamine. The first dose was 0.3 gram. Weakness and pain in the chest after that dose gave warning of possible trouble. During the following week he was given four mercurial inunctions. One week after the first intravenous injection of neoarsphenamine the dose of 0.3 gram was repeated. He was kept in bed for seven hours and then, feeling all right, he was allowed to get up. About 14 hours after the injection he complained of extreme weakness, pain in the chest and difficulty in breathing. His temperature by axilla was found to be 104.2° F. The pulse rate was 124, and respirations 30. Sodium thiosulphate, 1 gram, was given intravenously at once and repeated six hours later. He complained of pain in his chest for several hours. After that he improved gradually and was normal on the fourth day.

As mentioned above, there were other instances of febrile reactions in which the symptoms consisted merely of fever alone or fever accompanied by headache with or without vomiting. In some of these cases exanthematous rashes appeared and in others they did not. The most pronounced manifestations may be grouped as follows:

	Cases
Fever .....	3
Fever, exanthematous rash, pains in legs.....	1
Fever, exanthematous rash, and coryza.....	1
Fever, exanthematous rash, and edema of face.....	1
Chill, high fever, headache, and erythema.....	2
Chill, fever, and diarrhea.....	1
Chill, high fever, vomiting, and feeling of suffocation.....	1
Chill and fever.....	1

One patient had repeated chills for two days without fever.

Altogether, the records show there were 22 febrile cases without cyanosis, shock, or other manifestations which would wholly justify us in classing them as vasomotor phenomena. Some of these may have been Herxheimer reactions but it is certainly true when reactions are grouped and studied along with those of more serious character that one becomes less and less inclined to class as Herxheimer reactions certain manifestations which have heretofore commonly been so regarded.

*Febrile reactions, presumably vasomotor phenomena, after arsphenamine injections.*—There were seven reports of reactions which appear to belong in this group. Five of the cases were quite similar. The manifestations were chills, fever, vomiting, prostration, and a moderate degree of shock. In one case there were sharp muscular pains. Symptoms developed within a few hours after injection and lasted 8, 8, 14, 20, and 30 hours, respectively. In one case the reaction occurred after the sixth injection of a first course; dose, 0.6

gram; one came after the fourth injection, second course; dose, 0.6 gram; two came after the sixth injection, second course; dose, 0.6 gram; and one followed the seventh injection, second course; dose 0.6 gram.

In view of the fact that these five patients had all had several injections previously without noteworthy reactions, the symptoms probably may not be regarded as Herxheimer reactions. One patient, however, had similar symptoms after his second injection, 0.45 gram, given one week after his first dose of 0.35 gram. Shortly after the injection he had a chill and vomited. After the chill his temperature was 104° F. A day or two later he developed jaundice. It is difficult to say whether the manifestations in that case should be classed as a Herxheimer reaction or regarded as vasomotor phenomena.

A patient who did not have syphilis, but was being treated for psoriasis, had received five previous injections of arsphenamine at weekly intervals, 0.35 gram each. After the sixth dose, also 0.35 gram, he had a chill a few minutes after the injection and his temperature rose to 102° F. He then began to have asthmatic breathing and became cyanotic. These symptoms disappeared after a hypodermic injection of adrenalin chlorid solution.

*Afebrile cases, neoarsphenamine.*—In sorting the cases reported by medical officers it appears that 36 afebrile reactions from neoarsphenamine were probably instances of vasomotor phenomena.

In 17 cases alarming shocklike symptoms developed immediately or within a few minutes after the injection. In 12 of these cases the manifestations were variously immediate shock; shock with signs of collapse; immediate shock with nausea and fainting; shock, dizziness, and weak pulse; cyanosis with rapid weak pulse; chill, cyanosis, and unconsciousness. In the other five cases the details were as follows: A man in the secondary stage of syphilis was given his fourth injection of neoarsphenamine. The doses were given weekly—0.45, 0.9, 0.9, and 0.9 gram. Fifteen minutes after the last injection was completed the patient became cyanotic and his pulse could not be felt. Respirations were shallow and rapid. The body was cold and covered with clammy sweat. He coughed up some blood-stained sputum. By auscultation the heart beats were counted, 145 per minute. The following day episcleral hemorrhage in the right eye was noted. The urine contained albumin and casts. All symptoms cleared up in 18 days.

A man who contracted syphilis in January, 1928, received seven injections of neoarsphenamine in April and May of that year; the first, 0.45 gram and the others, 0.9 gram. His second course began June 20 with 0.45 gram. One week later he was given 0.9 gram

with no ill effect. July 3, about half of a 0.9 gram dose had been injected when he became nauseated and cyanotic, and his pulse was found to be weak and rapid. Sodium thiosulphate, 0.5 gram, was given intravenously at once. The next day there was a large amount of albumin in the urine. He recovered fully in four days.

In another case the patient was given two injections of neoarsphenamine, after which a skin eruption appeared and arsenical treatment was discontinued. Six months later a 0.6 gram dose was injected. Immediately the patient became cyanotic and began to vomit. There was persistent retching. Two hours later a specimen of urine contained 0.5 per cent of albumin. The patient recovered in five days.

In 1925 a patient became dizzy and vomited a few minutes after an intravenous injection of neoarsphenamine. He then went into a state of profound shock which lasted for about an hour. At the height of the reaction his pulse could not be felt and heart sounds could not be heard. He appeared to be dying but he recovered. Dosage was not stated in the record of the case.

The following case is of interest in view of delay in the onset of symptoms. A man in the secondary stage of syphilis was given 0.9 gram of neoarsphenamine in 1926. The dose was repeated seven days later. Twenty-four hours after the second dose the patient had a chill, vomited and became very weak. Manifestations of shock increased in intensity and 12 hours later he was transferred to hospital in a state of apparent collapse with his temperature 95° F. and pulse rapid and weak. At that time he was clouded mentally and disoriented. His face was congested and his eyes seemed to be protruding. There was retention of urine but a catheter specimen was normal. He was given sodium thiosulphate intravenously once a day for three days. He recovered fully in five days.

In the remaining 19 cases the symptoms were not at any time really alarming but they probably belong to the group, vasomotor phenomena. In six cases the patients complained of numbness and tingling sensations shortly after the injection. One of these patients received five injections of neoarsphenamine; the first, 0.6 gram, and the others, 0.9 gram. Five hours after the last dose he complained of tingling in his feet, hands, and arms. He was found to have complete loss of sensation in the affected areas with partial paralysis. He was given 1 gram of sodium thiosulphate intravenously at once and the dose was repeated each day for two days. He seemed to have recovered the third day. Another patient had similar symptoms after his fifth injection of neoarsphenamine. In both cases injections of bismudol were given between doses of neoarsphenamine.

Anesthesia and paresthesia are not peculiar to neoarsphenamine. Intramuscular injections of oil of chenopodium in filarial subjects not infrequently give rise to these symptoms. Numbness and tingling sensations were mentioned by a number of patients having other types of reactions after neoarsphenamine. Curiously, different lot numbers supplied by one manufacturer were involved in all but one or two instances in which numbness and tingling were prominent features.

In the remaining 13 cases of this group a variety of symptoms were recorded. Two patients had headache, dizziness, weakness, and nervousness for a few hours after the injection. One patient had violent pains in the abdomen, arms, and legs with severe muscular contractions and continuous vomiting. These symptoms came on one hour after the injection of 0.6 gram of neoarsphenamine. The patient had contracted syphilis five years before. He had had much previous treatment with neoarsphenamine and mercury. Hypodermic injection of adrenalin chlorid solution was followed by much relief in the course of 20 minutes. Severe headache continued for two hours and then the patient went to sleep. Treatment with arsenic was discontinued.

In two cases the symptoms were limited to headache, vomiting, and abdominal cramps, and in eight cases the symptoms were immediate in onset and suggested a mild degree of shock. In one of these cases the pulse rose to 134, five minutes after the injection and then suddenly dropped to 40 beats per minute. *Bradycardia* lasted for about two hours.

*Afebrile reactions, arsphenamine.*—Only one such reaction has been recorded. The patient had had seven previous doses of arsphenamine without a reaction. He was given as his eighth dose, 0.4 gram. While still on the table he began to breathe rapidly and with difficulty and became cyanotic. The eyelids, nose, lips, and cheeks rapidly became edematous, and in a few minutes he became nauseated and vomited. Cyanosis lasted for five minutes but he continued to vomit for several hours. He felt well the next morning.

*Neoarsphenamine ratios which may be of interest for vasomotor phenomena.*—Excluding 22 febrile reactions which perhaps should not be classed as vasomotor phenomena, there were reported during the 4-year period, 1925–1928, 47 reactions with symptoms ranging from mild to severe and alarming, including two fatal cases, resulting from the administration of neoarsphenamine, in which cyanosis, signs of shock, or certain combinations of other manifestations, seem to justify classing them as vasomotor phenomena, using the term with its connotations as discussed above. One of the fatal cases is listed in table 3 as acute poisoning by arsenic after a single

dose of 0.4 gram of neoarsphenamine, terminating in death 31 hours after the injection.

The figures indicate, then, a case fatality rate of 4.25 per cent in cases of vasomotor phenomena caused by intravenous injections of neoarsphenamine.

The incidence of such phenomena, the expectancy based on the experience of four years, 1925-1928, including cases ranging from mild to fatal, would be one reaction of this character for 274 cases of syphilis treated, and one to 5,055 intravenous doses of neoarsphenamine. There was one fatal reaction for 6,440 cases of syphilis treated and for 118,799 doses of neoarsphenamine administered.

Arsphenamine neutralized was not responsible for any fatal cases of this character during the 4-year period. There were 11 reactions of this nature after injections of arsphenamine; all but 3 severe in character. This figure makes the expectancy one reaction to 2,057 doses of arsphenamine administered. We do not know how many syphilitic patients were treated with arsphenamine.

The apparently greater frequency of occurrence of vasomotor phenomena after arsphenamine injections was possibly due to incomplete neutralization of the acid drug in certain instances. Four of the 11 reactions mentioned occurred in the same naval hospital in June, 1926. With proper care in preparing the solution there is probably less risk of encountering a reaction of the anaphylactoid type with arsphenamine than with neoarsphenamine.

Neoarsphenamine is not so stable; has not the keeping qualities of arsphenamine. When vasomotor phenomena occur the question arises whether the reaction was due to deterioration of the drug, or lack of proper care in preparing the solution, bad injection technique, or idiosyncrasy on the part of the patient. It is difficult to settle such questions. In the cases of acute hemorrhagic encephalitis studied there has been fairly satisfactory evidence pointing to special susceptibility on the part of the victims. The evidence is by no means so clear for vasomotor phenomena, but very likely idiosyncrasy for the drug or acquired sensitiveness has been a factor in most cases. Proper evaluations respecting these points must be left to the future.

Four years ago we were inclined to believe that neoarsphenamine produced by a certain manufacturer was especially apt to cause severe anaphylactoid reactions. Figures for the whole 4-year period are as follows:

TABLE 7

Manufacturer	Number of doses of neoarsphenamine administered	Number of reactions, vasomotor phenomena	Ratio
A-----	34, 119	36	1 to 948.
B-----	154, 840	7	1 to 22,120.
C-----	11, 201	2	1 to 5,600.
D-----	33, 028	1	1 to 33,028.
E-----	1, 597	1	1 to 1,597.

During the last two years of the period the results were as follows:

TABLE 8

Manufacturer	Number of doses of neoarsphenamine administered	Number of reactions, vasomotor phenomena	Ratio
A-----	15, 588	9	1 to 1,732.
B-----	80, 884	4	1 to 20, 221.
C-----	10, 393	2	1 to 5,197.
D-----	32, 840	1	1 to 32, 840.
E-----	251	1	1 to 251.

The product of "A" was involved in one of the fatal cases and the product of "B" in the other.

Three lot numbers furnished by "A" were withdrawn from the Navy in 1924 and 1925. Large numbers of cartons of these lot numbers were examined in the United States Hygienic Laboratory, especially cartons returned by ships which had been cruising in tropical waters and cartons sent in from naval stations in warm climates where the drug presumably had not been kept in cool or cold storage. Most cartons failed to show any evidence of deterioration but some cartons of each lot number contained one or more ampules the contents of which were more toxic for rats than when originally examined for release, or the drug had changed in color or failed to go into solution quickly and properly. It therefore appeared that deterioration was a potential hazard. It was considered a suitable precaution not to use neoarsphenamine that was more than 2 years old or arsphenamine more than 3 years old, although the latter may be expected not to deteriorate appreciably in the course of five years or more under ordinary conditions of storage. The United States Naval Medical Supply Depot, Brooklyn, N. Y., arranged to purchase only recently released lots of neoarsphenamine in order that the supply depots at Mare Island, Calif., and Canacao, P. I., might be provided with fresh stock not more than 6 or 8 months old.

There is reason to believe that if neoarsphenamine is going to deteriorate it is likely to do so within a few months after it is manufactured. Medical officers were advised to keep neoarsphenamine in dark and cool or cold storage under the supposition that the drug would be less likely to deteriorate under such conditions. But the only way in which a medical officer can safeguard his patients is personally to inspect each and every ampule immediately before the drug is administered. Inspection should take into consideration color change and appearance of the dry powder. The powder should dissolve completely without delay and the solution should not have an unusual color. Some care is required to make sure there is not a fine precipitate in the solution. If there is, the solution should not be used.

#### DERMATITIS AND DERMATITIS EXFOLIATIVA

*Fatal cases.*—One death occurred in 1927 and three in 1928; none in 1925 or 1926. A search of the mortality records of the Navy for the five years previous to 1925, when we began to collect data pertaining to the toxic effects of arsenical compounds, failed to bring to light any case in which death might have resulted from arsenical dermatitis. The vital statistics of the Navy for the calendar year 1921 show one death from dermatitis, unqualified, but if there was any connection with syphilis or with arsenic we are unable to trace it at this time.

The patient who died in 1927 was a young man, 22 years old, in the early secondary stage of syphilis. He received only three doses of neoarsphenamine—0.6 gram, August 4; 0.9 gram, August 9; and 0.9 gram, August 16. Daily inunctions of mercurial ointment were given in conjunction with the neoarsphenamine. Three days after the third dose of the latter a generalized erythematous eruption appeared. In the course of 10 days that went on to fissuring, oozing, crusting, and exfoliation. Sodium thiosulphate was given intravenously, 1 gram daily, but the total amount given was not stated. There was no jaundice and the urine remained normal to the end. Heart action gradually became weak and irregular. The patient died 30 days after the last dose of neoarsphenamine.

The first death in 1928 was that of a seaman, first class, 18 years old. The diagnosis of syphilis was made by finding the *Treponema pallidum* in the initial lesion June 20, 1928. Treatment began three days later and was continued as follows:

June 23: Neoarsphenamine, 0.45 gram.  
June 29: Metallic bismuth, 0.13 gram.  
June 30: Neoarsphenamine, 0.45 gram.  
July 6: Metallic bismuth, 0.13 gram.

July 14: Neoarsphenamine, 0.45 gram.  
July 20: Metallic bismuth, 0.13 gram.  
July 28: Neoarsphenamine, 0.45 gram.  
August 2: Metallic bismuth, 0.13 gram.  
August 4: Neoarsphenamine, 0.45 gram.  
August 18: Neoarsphenamine, 0.9 gram.

Thus, 3.15 grams of neoarsphenamine were given in the course of 56 days, an average of 55 milligrams per day. Twenty-four hours after the last dose the patient complained of headache and itching of the body. He was found to have an erythematous rash on his arms and body. His temperature was 99.6° F. The next day the skin was thickened and red on the flexor surfaces of elbows and knees, and there was a firm swelling of the upper lip and tip of the nose. He was then given 1 gram of sodium thiosulphate intravenously. The report of the case does not indicate how many doses were given subsequently. During the next seven days the lesions progressed as in cases of dermatitis exfoliativa and then, while much oozing and crusting and exfoliation was taking place, broncho-pneumonia developed and the patient died on the twelfth day of the pneumonia, 21 days after the last dose of neoarsphenamine. His temperature rose to 107° F. before death.

The second death in 1928 was that of a private, United States Marine Corps, 26 years old. He contracted syphilis in Shanghai, China, in June, 1928. The diagnosis was established by finding *Treponema pallidum* in the primary lesion June 29. Treatment began the next day and was continued as follows:

June 30: Neoarsphenamine, 0.45 gram.  
July 3: Mercury salicylate, 1 grain.  
July 7: Neoarsphenamine, 0.6 gram.  
July 10: Mercury salicylate, 1 grain.  
July 14: Neoarsphenamine, 0.6 gram.  
July 17: Mercury salicylate, 1 grain.  
July 21: Neoarsphenamine, 0.75 gram.  
July 24: Mercury salicylate, 1 grain.  
July 28: Neoarsphenamine, 0.9 gram.  
July 31: Mercury salicylate, 1 grain.  
August 4: Neoarsphenamine, 0.9 gram.  
August 7: Mercury salicylate, 1 grain.  
August 11: Neoarsphenamine, 0.9 gram.  
August 14: Mercury salicylate, 1 grain.  
August 18: Neoarsphenamine, 0.9 gram.  
August 21: Mercury salicylate, 1 grain.

Thus, 6 grams of neoarsphenamine were given in the course of 50 days, an average of 120 milligrams per day.

August 18, eight hours after the last dose of neoarsphenamine, the patient had some sort of reaction lasting for a few hours but the nature of it was not stated. Six days later he had an erythema-



tous and papular eruption over the entire body. At that time his temperature was normal. His urine was normal. About one week after that desquamation or exfoliation began. With the first indication of dermatitis 1 gram of sodium thiosulphate was given intravenously twice daily for two days and thereafter once daily for eight days. On the nineteenth day of the dermatitis there were small superficial skin abscesses on the arms, back, and thighs. There was no fever. On the twenty-second day of dermatitis, otitis media developed in the left ear and the patient began to cough. Signs of broncho-pneumonia developed. There were repeated chills. The temperature ranged from 99.8° to 102.6° F. During the last few hours of life the temperature was subnormal. Death occurred on the thirty-fourth day of dermatitis, 40 days after the last dose of neoarsphenamine.

Post-mortem examination revealed innumerable small abscesses scattered through both lungs. About 100 cubic centimeters of bloody fluid was found in the right pleural cavity and about 350 cubic centimeters of seropurulent fluid in the left pleural cavity. The heart was normal. The kidneys were large. There was nothing remarkable about the liver. The brain was not examined.

The third death in 1928 was that of a seaman, second class, 22 years old, who contracted syphilis in July, 1928. He presented a primary lesion August 9 and had a strongly positive Kahn test August 15. Treatment began August 23 and was continued as follows:

- August 23: Neoarsphenamine, 0.45 gram.
- August 27: Neoarsphenamine, 0.45 gram.
- August 30: Neoarsphenamine, 0.45 gram.
- September 5: Potassium bismuth tartrate with butyn, 0.1 gram.
- September 6: Neoarsphenamine, 0.45 gram.
- September 10: Neoarsphenamine, 0.45 gram.
- September 12: Potassium bismuth tartrate with butyn, 0.1 gram.
- September 14: Neoarsphenamine, 0.45 gram.
- September 17: Neoarsphenamine, 0.45 gram.
- September 19: Potassium bismuth tartrate with butyn, 0.1 gram.
- September 20: Neoarsphenamine, 0.45 gram.
- September 24: Neoarsphenamine, 0.45 gram.
- September 26: Potassium bismuth tartrate with butyn, 0.1 gram.

Thus 4.05 grams of neoarsphenamine were given in the course of 28 days, an average of 145 milligrams per day.

No noteworthy reaction occurred after any of the injections of neoarsphenamine. Three days after the last dose of arsenic a scabby itching eruption appeared on the hands and arms, followed in a few hours by similar lesions on the feet and ankles. At the same time numerous purpuric spots appeared on the trunk and thighs. The patient's temperature rose to 102.4° F. His urine was

normal. After a couple of days the skin of the hands and feet loosened in a castlike manner, and two days after that exfoliation began on the trunk. On the third day of dermatitis 0.5 gram of sodium thiosulphate was given intravenously. A dose was injected each day for six days, with the amount increased daily by 0.1 gram. On the seventh day after the appearance of skin lesions there were skin was exfoliating all over the body and the patient's condition was bad. The pulse was rapid and feeble. He seemed better, however, a few days later. Desquamation was less marked and his temperature, pulse, and respirations were normal for two days. His temperature then rose to 102.2° F. and abscesses appeared on his right wrist and back. They were incised and drained. Septicopyemia then developed, and death occurred on the twenty-fifth day of dermatitis, 28 days after the last dose of neoarsphenamine. Autopsy was not performed.

*Nonfatal cases of dermatitis exfoliativa or arsenical dermatitis.*—

When arrangements were made in November, 1924, to begin the collection of data pertaining to toxic effects of arsenical compounds used in the treatment of syphilis, stress was laid on the term "severe reaction." It is possible, therefore, that cases of dermatitis developing in the course of treatment, especially the milder ones, were not regarded as cases which should have been reported under the instructions issued by the Bureau of Medicine and Surgery. Moreover, a number of cases in which dermal lesions of relatively minor importance were reported were not taken into consideration when analyzing the data during the first two years of this study. In 1925, eleven cases were reported by the United States Naval Hospital, New York, in which skin lesions of one sort or another developed. None of those was a frank case of dermatitis exfoliativa and there was no great damage in any of the cases. It seemed at the time they might be classed as instances of subacute arsenical poisoning resulting from cumulative action of the drug, neoarsphenamine, which was of a lot number known to be therapeutically potent. The practice, it appeared, at that hospital then was to give each syphilitic patient moderately sized doses of neoarsphenamine twice or thrice a week. The results bordered on dermatitis exfoliativa.

During the year 1926 only one definite case of dermatitis incidental to the treatment of syphilis was reported. Certainly the incidence of true cases of dermatitis exfoliativa increased in 1927 and again in 1928. Inasmuch as no death from this condition occurred until 1927, so far as can be determined, the nonfatal cases of 1927 and 1928 may well be taken to indicate the case fatality rate. During those two years there were 20 cases with symptoms and signs ranging from mild to severe. Including the 4 fatal cases,

there were 24. So far as these figures go, therefore, the case fatality rate was 16.67 per cent. The figures are for neoarsphenamine.

Among these there were 5 cases in which suspicious eruptions developed and disappeared in from 5 to 10 days. In each of these cases the use of neoarsphenamine was discontinued and no further damage resulted. One of the patients had a rash after his first dose, which consisted of 0.45 gram, and again a month later after his second dose of 0.6 gram. Each time with the appearance of the rash there was high fever. He was tried again two weeks later with 0.6 gram, and a similar skin eruption, more severe in character, accompanied by edema of the feet, developed eight hours after the injection. He was given 1 gram of sodium thiosulphate intravenously on alternate days for a total of three doses. Treatment with arsenical compounds was abandoned.

Another of these five patients was given 0.45 gram of neoarsphenamine and 0.6 gram one week later. Four days after the second dose he had fever of 102° F., a hemorrhagic rash on his body, and edema of his feet and eyelids. He was given sodium thiosulphate intravenously, 1 gram daily for five days. The rash disappeared and his temperature reached normal in nine days. About 40 days later 0.45 gram of neoarsphenamine was injected. He had a pronounced febrile reaction and two days later a rash appeared on his forearms and chest. There was also some edema of his hands and eyelids but no fever. Sodium thiosulphate was again administered and the symptoms disappeared promptly. He was regarded as having low tolerance for arsenic and the use of neoarsphenamine was discontinued.

Another of these patients showed a premonitory rash after his second dose of neoarsphenamine. He was in the early secondary stage of syphilis. The amounts of neoarsphenamine used for the first and second doses were not stated. He had a marked reaction after the first dose, during which the syphilitic eruption was intensified. His temperature rose to 103° F. The second dose was administered five days after the first. A few hours later his temperature rose to 103° F. and the following day he showed a fine red rash over the entire body. His temperature remained elevated for four days. During that period he was given a daily intravenous injection of 1 gram of sodium thiosulphate. There was no desquamation and he had no jaundice, but at times there was a trace of albumin in the urine. Treatment of the syphilitic infection was then continued with mercury, iodides, and bismuth. Four weeks after the second dose of neoarsphenamine he was tried with 0.15 gram. Within 10 hours his temperature rose to 103.4° F. He was then given 1 gram of sodium thiosulphate intravenously. No skin eruption appeared.

After another interval of four weeks he was given 0.1 gram of neoarsphenamine. After that dose his temperature rose only to 99.6° F. and the following morning his temperature was normal. The medical officer then decided to try the injection of a gram of sodium thiosulphate shortly before injecting neoarsphenamine. In that manner 0.2 gram of neoarsphenamine was administered with no reaction and it was considered likely that larger doses could be administered safely.

The next case in this series of five mild cases of dermatitis was that of a man whose treatment began in the primary stages of syphilis. He contracted the disease in January, 1926. Between February 4 and March 31 of that year he received eight injections of arsphenamine. Between May 5 and August 5, 1926, he had two doses of arsphenamine and six doses of neoarsphenamine. Between May 26, 1927, and June 30 of that year, he had six doses of neoarsphenamine. The last dose of that course was 0.9 gram. About 48 hours after that injection he complained of burning and itching sensations in the skin of the abdomen, back, face, and arms. There was noticeable swelling under his eyes and the whole face had a puffed appearance. The tongue was fissured. Treatment with neoarsphenamine was not resumed until January 17, 1928, when 0.45 gram was given. He had a similar reaction. Sodium thiosulphate, 1 gram, was administered intravenously three days later and the symptoms of arsenical poisoning subsided 24 hours after that.

The last of these five mild cases of dermatitis was that of a man who had had three full courses of neoarsphenamine—amounts and intervals not stated. Four days after the seventh dose in his fourth course, consisting of 0.9 gram of neoarsphenamine, scattered dark red maculo-papular lesions appeared on his body. With the lesions he had a burning sensation. No attention was paid to these warning signs and one week later another 0.9 gram dose was injected. The following day the skin lesions were aggravated and more extensive. Fortunately the consequences were not very serious. The patient seemed to respond to sodium thiosulphate. He was on the sick list only five days.

Including 1 case reported in 1926, but not including the 4 fatal cases which are described above, there were 16 cases of pronounced dermatitis exfoliativa resulting from treatment with neoarsphenamine. Some of the available data for these cases, especially information pertaining to previous treatment and amounts of the drug administered during the last or current course of treatment, etc., are best studied in tabular form. The data are as follows:

TABLE 9

Previous courses of treatment	Current course of treatment						Onset of dermatitis after last dose	Duration of dermatitis
	Dose followed by dermatitis	Total grams	Number of days in course	Average milligrams per day	Concurrent treatment	Days		
None.....	Tenth.....	6.95	63	110	Mercury salicylate, 20 grains.	3	55	
Do.....	Ninth.....	7.65	56	136	Mercury salicylate, 10 grains.	( <sup>1</sup> )	32	
Do.....	Eighth.....	6.00	54	111	do.....	10	( <sup>2</sup> )	
Do.....	do.....	7.20	49	147	16 inunctions, mercurial ointment.	( <sup>1</sup> )	72	
Do.....	Seventh.....	6.30	42	150	None recorded....	1	103	
Do.....	Seventh (?).....	5.05(?)	42	118(?)	do.....	4	120	
Do.....	Sixth.....	3.60	35	103	do.....	2	48	
Do.....	do.....	4.95	35	141	Potassium iodid, 10 grains to toleration.	3	91	
Do.....	do.....	4.94	35	141	do.....	3	63	
Do.....	Fifth.....	4.50	28	160	Mercury salicylate, 2 grains; daily inunctions, mercurial ointment.	5	47	
Not recorded.....	do.....	4.10	28	144	Bichlorid of mercury, 2½ grains.	( <sup>3</sup> )	30	
Do.....	do.....	4.50	35	128	Not recorded....	5	37	
First course, Jan. 15, to Apr. 6, 1927. Second course, May 24, to July 12, 1927.	9 doses, Sept. 13, to Nov. 15, 1927.	6.90	63	109	Mercury salicylate, 9 grains.	10	30	
Two courses, amounts and dates not stated.	Eighth.....	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	Not recorded....	1	( <sup>4</sup> )	
First course early in 1927. Second course, Nov. 18, to Dec. 7, 1927, followed by dermatitis with 55 sick days.	First (0.5 gram Sept. 18, 1928).	0.5			None.....	( <sup>5</sup> )	62	
First course, Mar. 21, to Apr. 27, 1928; 1.7 grams of arsphenamine. Second course, May 3, to June 21, 1928; 6.3 grams of neoarsphenamine. Third course, Aug. 1, to Sept. 7, 1928; 5.6 grams of neoarsphenamine.	Second (0.6 gram Oct. 12, 1928, and 0.6 gram Oct. 19, 1928).	1.20	8	150	Daily inunctions of mercurial ointment.	5	16	

<sup>1</sup> Not recorded.<sup>2</sup> Transferred from Asiatic Station to United States.<sup>3</sup> Few hours.<sup>4</sup> Unknown.<sup>5</sup> Two hours.

It will be noted that in all but two of these cases the patients had recently had from 5 to 10 doses of neoarsphenamine in periods ranging from one to two months, with varying amounts of the drug averaging from about 100 to 160 milligrams per day over the period comprising the current course of treatment, until treatment was discontinued because of the intercurrent of dermatitis. The fact that most of the patients had also been taking mercury, bismuth, or potassium iodide will also be noted. We have no data for compar-

ative purposes which would indicate the significance of such concurrent treatment. One of the patients had had dermatitis exfoliativa with 55 sick days about 10 months before he again became a victim of this condition after a single dose of 0.5 gram of neoarsphenamine. Another patient was just beginning his fourth course of neoarsphenamine injections after an interval of one month when he developed a comparatively mild case of exfoliating dermatitis five days after the second dose of the fourth course. During his first course he averaged 48 milligrams of arsphenamine per day. During his second course he averaged 128 milligrams of neoarsphenamine per day, and during the third course, 151 milligrams of neoarsphenamine per day.

It would be interesting to know how many men have received more than 100 milligrams of neoarsphenamine per day per 1,000 patients treated, over comparable periods, without any untoward effects, but that information is not available. The data presented here seem to suggest that a considerable percentage of patients at least have their tolerance for neoarsphenamine exceeded when the drug is administered at an average of more than 100 milligrams per day for a period of more than a month.

The 24 fatal and nonfatal cases of exfoliative dermatitis which occurred in 1927 and 1928 represent 1 case for 288 cases of syphilis treated, or 1 death from dermatitis exfoliativa to 1,731 cases of syphilis treated.

It is interesting to note that neoarsphenamine produced by manufacturer "A," which figured prominently in vasomotor phenomena, was not associated with any case of dermatitis exfoliativa although large quantities of that product were used very generally in the Naval service every year. On the other hand, neoarsphenamine "D" was associated with 10 of the 24 dermatitis cases but with none of the hemorrhagic encephalitis cases and was responsible for only one severe reaction of the vasomotor type. Altogether, 32,840 doses of the "D" product were administered in the Navy during 1927 and 1928.

Probably the make of the neoarsphenamine has relatively little to do with the causation of arsenical dermatitis in comparison with such factors as tolerance of the individual, period of time over which the treatment extends, total amount of arsenic injected, and the average number of milligrams per day. Since we have the figures for the products of different manufacturers, however, we will include them.

TABLE 10

Manufacturer	Number of doses of neoarsphenamine administered in 1927 and 1928	Number of cases of dermatitis	Ratio
A-----	15, 588	0	
B-----	80, 884	11	1 to 7,353.
C-----	10, 393	2	1 to 5,197.
D-----	32, 840	10	1 to 3,284.
E-----	251	0	
Unknown-----		1	

*Clinical manifestations in pronounced cases of dermatitis exfoliativa.*—Besides the four fatal cases described above, there were 16 severe cases. In 4 of the 16 a dose of neoarsphenamine was injected after the appearance of a maculo-papular rash or eruption about the genitals, fingers, and toes, presumably caused by arsenic already administered. In one other case there were premonitory indications of danger. In that case, after the fourth dose of the current course there was itching of the soles of the feet and palms of the hands. Two more doses were injected. Two days after the sixth dose the patient complained again of itching of the palms and soles, and also of numbness and tingling sensations. The next day exfoliative dermatitis began.

In the other 11 cases the dermatitis began and progressed to exfoliation without premonitory symptoms or signs.

Signs and symptoms noted at the time of onset or early in the course of dermatitis were moderate elevation of temperature, increased pulse rate, headache, pain in the epigastrium, congestion of the conjunctivae, inflammation of the mucous membrane of the nose and throat, vertigo or dizziness, and in one case, jaundice.

In most of the cases dermatitis began over extensive areas with maculo-papular lesions. In some cases marked thickening of the skin was mentioned. In several cases vesicles developed and there was a good deal of weeping and crusting. Extensive desquamation or exfoliation began usually in from 5 to 14 days after the appearance of the rash and continued for one to three weeks. In one case the skin of the head, arms, body, and legs exfoliated three times. In several cases there were large pieces of exfoliated epithelium. One medical officer mentioned "cast-like" exfoliation from fingers. Edema of the face and neck was reported in one case. That patient later developed pneumonia and recovered. Arthritis of the knees and ankles was a complication in one case, and in another, multiple subcutaneous abscesses developed in the course of

exfoliation. In two cases there was enlargement and tenderness of the liver with jaundice. The four fatal cases with their complications have been described separately in some detail above.

*Arsphenamine in relation to dermatitis exfoliativa.*—Only two cases of dermatitis attributable to arsphenamine have been reported; one in 1927 and one in 1928. Available data do not show how many cases of syphilis were treated with arsphenamine alone as the arsenical compound, or partly with arsphenamine and partly with neoarsphenamine. With respect to the number of doses of arsphenamine administered, these 2 cases represent 1 case of dermatitis exfoliativa to 5,421 doses administered in 1927 and 1928. While this ratio has not much significance it is of some interest to compare it with the corresponding ratio for neoarsphenamine—1 to 5,840.

The 1927 case was possibly due not so much to arsphenamine as to potassium bismuth tartrate and mercury. The patient contracted syphilis in June, 1927. Treatment was begun June 30 with 0.3 gram of arsphenamine. He was given six more injections at weekly intervals, 0.6 gram at each dose. Concurrently he took mercurial inunctions as well as potassium iodide for one month. He received no more antisyphilitic treatment until October 12, 1927, when he was given 0.3 gram of arsphenamine intravenously. That dose was followed by fever and abdominal pain which continued for three days. One week later he was given 0.6 gram of arsphenamine and he had a similar reaction. The next week the dose was reduced to 0.3 gram. That was also followed by a severe reaction and the use of arsphenamine was stopped. Treatment was then continued with four injections at weekly intervals of potassium bismuth tartrate, 0.1 gram each, with 0.6 per cent butyn sulphate suspended in oil. Five days after the last injection he complained of sore mouth and itching hands and scrotum. He was found to have a papular rash on the dorsal surfaces of his hands and forearms and on the neck and face. His scrotum was red and swollen. His tongue showed a thick whitish coating and his gums were very sore. The skin lesions progressed and in the course of five more days his hands, arms, and face became greatly swollen and there was much "weeping" from the lesions. There was then a scarlet rash on the shoulders, back, and chest with many areas of eczematouslike lesions and edema about the eyelids. There was suppression of urine and the small amounts voided contained 2 or 3 per cent of albumin, blood, and many hyalin and granular casts. His feet and legs became edematous. Desquamation of the skin of the scrotum began on the fifth day of dermatitis, and of the palms of the hands and soles of the feet on the twenty-third day. The patient improved and was allowed up and dressed on the thirty-fifth day. At that time he was passing 2,000 cubic centimeters or more of urine in 24 hours. The urine was still cloudy and reddish



brown in color, and it contained a trace of albumin, many red blood cells, and an occasional granular cast.

The patient in the 1928 case contracted syphilis in Shanghai, China, in October, 1927. He had his first course of arsenical treatment between January 4 and March 13, 1928—eight injections of neoarsphenamine, amounts not reported. Apparently he had no more antisypilitic treatment until August 22, 1928, when he was given 0.2 gram of arsphenamine. Eight hours after the injection he complained of severe headache, pain in his back, and chilly sensations. He was nauseated and vomited three or four times. His skin became fiery red and broke out with red papules. Presently edema of the eyelids was noticed. These symptoms appeared in the course of a few hours. Four hours after the onset of the reaction 1 gram of sodium thiosulphate was given intravenously, and 1 gram was also given by mouth. Two more 1-gram doses were given intravenously at intervals of two days. This treatment was given at the United States Naval Hospital, Chelsea, Mass., to which the patient was transferred 12 hours after the injection of arsphenamine, which had been given at the hospital in the morning. The erythematous flush was most pronounced about the head. Papules were especially thick on the flexor surfaces of the forearms, and some of them progressed to pustules. Lesions appeared on the palms of the hands, and later there were crusty pustular lesions on the dorsal surfaces of the feet. The lesions on the palms and soles were papules.

The skin lesions were treated with ammoniated mercury ointment and calamine lotion. The dermatitis gradually became worse. One month after the onset treatment with potassium iodide was tried. Two months after admission to hospital the skin of the flexor surfaces of the elbows and knees was thickened and deep red in color with a glistening surface. There were still lesions on the palms of the hands. During the next two weeks nine injections of sodium thiosulphate, 0.7 gram each, were given. At the end of that series all lesions were clearing up except those on the palms of the hands, where small deep-seated white vesicles were constantly recurring. Many of those broke down and ulcerated. Such vesicles were developing at the time he was discharged to duty, 100 days after admission.

The report of this case included a statement that the patient was given no drugs other than those mentioned. It seems incredible that 0.2 gram of arsphenamine should have given rise to the dermatitis. It is impossible to judge how much the lesions were aggravated by ammoniated mercury and potassium iodide, but the lesions were present before those substances were introduced. There was a lapse of about five months after a course of eight injections of neoarsphenamine.

This case is of interest in connection with the discussion of epidermal elimination of arsenic which appeared in current comment, *Journal of the American Medical Association*, August 24, 1929. The writer referred to the studies of arsenic excretion in hair, by Althausen and Gunther, of the University of California. They concluded that although arsenic does not appear in the hair very early, surprising at it may seem, the arsenic content of hair eventually surpasses that of all other tissues in subacute and chronic cases of arsenical poisoning, the liver being the only organ which occasionally shows a greater amount of arsenic than is contained in the hair. Hair was found to contain arsenic much longer than any other structure of the body, including the liver and the skeleton. This is accounted for by continuous deposition in the hair of arsenic from all over the body. Althausen and Gunther consider that the arsenic occurs in the hair in a fixed state and is not reabsorbed either spontaneously or through the influence of sodium thiosulphate. May not arsenic in the skin, where it is not removed by deposition in hair, cause irritation and give rise to dermatitis, particularly when more arsenic is introduced intravenously at a later date? The point made by the writers quoted does not concern us here particularly. It was that the delayed appearance of arsenic in the hair, its relatively high arsenic content, and the length of time the poison can be detected there, make hair one of the most valuable objects for analysis in cases of suspected arsenic poisoning.

MISCELLANEOUS EFFECTS FOLLOWING THE ADMINISTRATION OF ARSENICAL COMPOUNDS

*Damage to the liver.*—Besides a few cases in which jaundice appeared as a symptom of relatively minor importance in connection with dermatitis exfoliativa or manifestations classed as vasomotor phenomena, jaundice was reported only in two instances. In one, jaundice appeared on the third day after the second of two doses of neoarsphenamine. The first dose was 0.5 gram and the second, 0.9 gram. Six hours after the second dose the patient's temperature was 102° F. and he complained of pain in his legs and back. He recovered completely in nine days. He gave an indefinite history of syphilis but had a strongly positive Kahn test.

The other patient was in the early secondary stage of syphilis. He received three doses of arsphenamine, seven days apart—0.3, 0.4, and 0.4 gram. After the third dose he had a moderately severe early febrile reaction with headache, giddiness, and vomiting. Six days later jaundice appeared and became intense on the tenth day. Nothing else worthy of note happened. Jaundice continued for 35 days and then cleared up, leaving no apparent damage to the liver.

These were instances of "early jaundice," coming on a few days after an injection of arsenic. Such cases are usually of no great consequence. In 1922 the Salvarsan Committee of the British Medical Research Council contemplated: (a) Early jaundice; mild and evanescent; (b) late jaundice, occurring not earlier than several weeks after the end of a course of treatment, more severe and prolonged than early jaundice; (c) acute yellow atrophy of the liver, often supervening on late jaundice.

The committee listed acute yellow atrophy of the liver next after hemorrhagic encephalitis among the most important ill effects following the administration of arsenical compounds which may end fatally. No case of acute yellow atrophy of the liver or of severe jaundice has occurred among the ill effects associated with the administration of the 272,354 doses of arsenical compounds in the United States Navy reviewed here. A fatal case, however, was reported in the United States Naval Medical Bulletin, April, 1930.

*Damage to kidneys.*—In all of the classified cases referred to or discussed above, the presence of blood, albumin, or casts in the urine or other evidence suggesting damage to the kidneys, if present, was mentioned. In one other case the urine contained albumin, red blood cells, and casts. The case was not classified. The patient, a young man in the secondary stage of syphilis, received four injections of arsphenamine seven days apart—0.3, 0.4, 0.5, and 0.6 gram. Between the third and fourth doses he received 0.4 grain of mercury succinimid intramuscularly and a similar dose two days after the last dose of arsphenamine. Several hours after the injection of the mercury he had a chill, vomited, was found to have a temperature of 102° F., and complained of pain in the epigastrium. He had diarrhea which had begun the day after his last dose of arsphenamine. The urinary findings suggested acute nephritis. Twenty-four hours after his chill, 0.5 gram of sodium thiosulphate was given intravenously, followed by 0.7 gram the next day and 0.7 gram the day after that. Vomiting continued for six days. There was still blood in the urine on the ninth day. He recovered slowly.

*Herxheimer reactions.*—There were only three of all the reactions reported which seem to fall into this class. These occurred after a first intravenous dose of an arsenical compound in patients having early secondary lesions of syphilis. In one case there was a chill five hours after the injection of 0.6 gram of neoarsphenamine, followed by rise of temperature to 104° F. The reaction lasted 12 hours. In another case there was a chill followed by temperature of 102° F. a few hours after the injection of 0.45 gram of arsphenamine. The other patient had nausea and vomiting beginning one hour after the injection of 0.3 gram of arsphenamine. His syphilitic skin eruption

was intensified and he felt faint and weak for several hours. Six days later he was given his second injection of arsphenamine and had no reaction.

Probably a good many mild reactions of this type have not been recorded. If there is intensification of a syphilitic skin eruption there is some basis for regarding the attending symptoms as a Herxheimer reaction. Otherwise it is difficult to distinguish between such a reaction, presumably resulting from the action of the drug on treponemas, and vasomotor phenomena. It seems probable that many cases in earlier years were regarded as instances of Herxheimer reactions when in reality they were not.

*Reactions of minor importance.*—In conclusion it should be mentioned that in addition to the 117 case reports used in preparing this article there were 111 reactions reported by medical officers. Each of those reports was considered and excluded as not furnishing evidence really significant of toxic effects worthy of note. Some medical officers report extremely mild reactions and others do not. Some of the mild reactions may be indicative of peculiarities of different ampules of the arsenical compounds, especially nearsphenamine, or of minor degrees of idiosyncrasies, but such mild manifestations could not be classified.

*Editorial comment.*—It is pertinent to remark in connection with the foregoing article that medical officers are not reporting all cases of poisoning by arsenical compounds on Form A, as required. A check of the Form F cards received by the bureau in 1928 showed 12 admissions for poisoning by arsphenamines. In but two instances were any of these cases reported on the monthly report of arsenical compounds administered required from all ships and stations. This involves considerable delay in obtaining data by means of a questionnaire which is forwarded to the medical officer concerned in each of these cases. The primary object of Form A is to obtain promptly all necessary data relative to each case of poisoning by an arsenical compound in order to determine if the arsphenamine represented by any particular lot number is responsible for an undue number of severe reactions. When this appears probable the contents of ampules bearing this lot number are tested for toxicity. If found to be toxic to laboratory animals, medical officers are immediately notified and the lot number recalled.

In each case of poisoning the following information should be included in the report:

Approximate time and place of infection.

How diagnosed.

Previous treatment with an arsenical compound:

Number of courses.

Approximate date of each course.

Course of treatment during which reaction occurred:

Size and date of each dose of an arsenical compound.

Size and date of each dose of mercury, iodine, bismuth, or other previous or concurrent treatment, and how administered.

Information regarding dose causing reaction (technique):

What was the dilution?

Rate of injection.

Size of dose:                      Lot No.

Name of preparation as labeled.

Name of manufacturer.

Time elapsing between the injection and the first symptoms of severe reaction.

Symptoms.

Treatment given for severe reaction. Was sodium thiosulphate administered; if so, state size of each dose, time of administration, and how administered.

Time of recovery.

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#### A DEATH FROM FOOD POISONING CAUSED BY OYSTERS

By D. O. ZEARBAUGH, Lieutenant (Junior Grade), Medical Corps, United States Navy

Sporadic cases of food poisoning or food infections from oysters are not infrequent. With careful supervision by State health authorities, of the beds and methods of handling, the number of cases has decreased. The two main sources of contamination of oysters by pathogenic organisms are by growth or storage in polluted waters and by carriers through carelessness in handling. Such infection does not noticeably alter their taste or appearance. State supervision of oyster beds has materially reduced the hazard of contamination in polluted waters. Information regarding the necessary sanitary measures to be observed in handling oysters has been widely disseminated among all dealers by local and State boards of health.

A corporal and a private of the Marine Corps ate fried oysters at the post restaurant, Marine Barracks, Quantico, Va. Both developed symptoms of food poisoning. The corporal died, the private recovered. There was no evidence of indulgence in alcoholic liquor.

The post restaurant was under the status of a concession and, while conducted by civilians, was under the close supervision of the post authorities. Since the occurrence of the two cases of food poisoning, it has been closed.

On the morning of January 5, 1930, the corporal was late for breakfast at the barracks. He had been granted 30 days' leave of absence and had returned two days previously, two days before his leave expired, but had not resumed his regular duties. About 10.30 a. m., accompanied by a private, he went to the post restaurant where they were served fried oysters, ketchup, and coffee.

Four other persons who had eaten oysters taken from the same can did not develop symptoms of poisoning. Ketchup from the same supply had been served to a number of men on the two preceding days. None of these men became ill. Information in the fatal case as to food eaten at other meals could not be elicited because of the fulminating nature of the attack. Also, the patient stated that since his return from leave he had not eaten at the barracks mess but had obtained his meals either at the post restaurant or at restaurants in the town of Quantico, Va.

Before they had finished eating, both felt nauseated. Both vomited upon leaving the restaurant. They then proceeded to dispensary No. 1, where they received treatment. Amelioration of symptoms with recovery followed in the case of the private. The corporal did not improve and was transferred to the sick quarters. He arrived there about 1.30 p. m., or about two hours after the first symptoms appeared, and was immediately attended by a medical officer.

The patient, upon admission to sick quarters, was in a state of shock and had an anxious expression. He complained of abdominal cramps which were spasmodic in character, and vomited continuously until shortly before death when he lapsed into coma. He had severe watery diarrhea but no abdominal distention. Temperature remained subnormal. There were no chills, headache, or muscular soreness. Sensation of numbness and tingling was present in the lower extremities. Later, cramps followed by tonic contractions of the extensor muscles of the lower extremities developed. Prostration was severe and gradually increased until death. No bitter taste or change in salivary secretion was complained of at any time. Slight diplopia and disturbance of accommodation developed after admission but no ptosis was noted. Pupils were normal in size and shape but reacted sluggishly. There was no flushing or pallor. The pulse, which was 96 on admission, increased to 130 beats per minute and became low in tension and slightly irregular both as to volume and rhythm. Blood pressure readings were not taken. The respiratory rate was about 24 per minute. There was no skin eruption. A white blood cell count showed 10,100 cells per cubic millimeter with 80 per cent polymorphonuclear leukocytes and 20 per cent lymphocytes. No urine was obtained for examination.

The patient was placed in a quiet room, treated for shock and given gastric lavage and enemas. He did not respond to stimulation or other treatment and died at 6.45 p. m. or about 8 hours after the oysters were eaten.

At necropsy the serous membranes of the stomach and small intestines were found to be injected. The colon was contracted. All

other organs were normal. The viscera were removed and sent to the United States Naval Medical School, Washington, D. C., for pathological, bacteriological, and chemical examination.

Gross examination revealed some congestion of the liver and kidneys. The stomach contained a bloody fluid and showed pinpoint areas of congestion in the mucosa. The microscopical findings were: Acute gastritis; acute congestion of the lungs, heart, liver, pancreas, spleen, kidneys, adrenals, and gastrointestinal tract; and acute parenchymatous degeneration of the heart, liver, and kidneys.

Chemical examination of the gastrointestinal contents, except for a trace of ethyl alcohol probably due to medication administered, was negative for metallic and other common poisons. Cultures from the gastrointestinal contents were negative for pathogenic microorganisms. Aerobic and anaerobic cultures were made from the oysters. A sluggishly motile gram negative bacillus, having many of the cultural characteristics of the *B. aertryck* and belonging to the paratyphoid-enteritidis group of microorganisms, was isolated from both. This microorganism did not agglutinate with specific antiserum obtained from the hygienic laboratory of the United States Public Health Service, nor with paratyphoid "A," "B," or enteritidis sera. Some of the oysters were fed to guinea pigs. The animals remained well. Stained smears made from the ketchup showed a gram positive coccus having the morphological characteristics of a pneumococcus. No microorganisms of the food poisoning group were found in cultures made from this material.

Acting on the supposition that the oysters may have been fattened in contaminated waters, the State Board of Health of Virginia was notified. In tracing the shipment they found that the gallon of oysters sent to the post restaurant was part of a shipment of 30 gallons which was delivered, well iced, in 5-gallon containers, to a market in Richmond, Va., on the morning of the preceding day. The oysters were packed by a concern which bears an excellent reputation and is located in a town on the Rappahannock River about 50 miles from that city. The remaining 29 gallons were distributed to dealers in Richmond. No other cases of disease have been attributed to this shipment and no case to previous shipments.

Oysters in the gallon sent to Quantico were dipped from the 5-gallon container and placed in paper receptacles, which were given to a man who transports laundry and other articles by motor vehicle to the Marine Barracks at Quantico. In his home they were transferred to a glass jar of 1-gallon capacity having a wide mouth and a screw top. According to this man's statement, the jar was packed in ice and delivered to the post restaurant about 3.30 p. m. on the day before the cases of food poisoning occurred. Attendants in the restaurant poured the oysters into a porcelain container, added ice, and

stored the container in the refrigerator. No restaurant in the town of Quantico or on this post purchases oysters from this source at the present time.

It seems probable, though one can not say definitely from the information furnished, that contamination of the oysters suspected as being the cause of the two cases of food poisoning occurred in the course of the various handlings to which they were subjected. The number of times these oysters were handled and the conditions under which they were changed from one container to another are entirely unnecessary in the distribution of an article of food as easily contaminated as oysters.

*Conclusions.*—Two cases of food poisoning occurred at the Marine Barracks, Quantico, Va., on January 5, 1930. One patient died in about eight hours after the onset; the other recovered. Oysters and ketchup were the suspected foods. A bacillus having many of the cultural characteristics of the *B. aertryck* was recovered from the oysters but not from the gastrointestinal contents in the fatal case. Blood cultures were not made. No member of the food-poisoning group of microorganisms was identified in cultures from the ketchup. It is believed that the conditions under which the oysters were handled permitted contamination, with the resultant production of thermostabile preformed toxin.

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#### THE VIRUS OF PARROT DISEASE<sup>1</sup>

The extensive investigations by Krumwiede and his associates at the health department's research laboratory show conclusively that the recent cases of parrot disease were not, as some seemed to think, merely instances of hysteria. In fact, even had these laboratory investigations not borne fruit, the evidence collected by Doctor Rosenbluth, chief diagnostician of the department of health, together with that collected by various health officers in other cities, indicated clearly that infected parrots reaching this city in November and December, 1929, were the cause of a considerable number of cases of parrot disease in humans, many of which cases were fatal.

An interesting report concerning the laboratory investigations made in connection with the recent cases of parrot disease has just been made to Commissioner Wynne by Dr. Charles Krumwiede, assistant director of the health department's research laboratory.

One of the parrots picked up during the outbreak of cases of parrot disease in this city was sick when encountered by an inspector

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<sup>1</sup> Reprinted from Weekly Bulletin, Department of Health, city of New York, Feb. 15, 1930.



of the department of health. This parrot was found in a home where it had seemingly given rise to two human cases of pneumonia which ran a course clinically like that of the other cases of pneumonia associated with parrot disease.

The parrot was taken to the health department's laboratory and bacteriological examination showed no evidence of infection by the *Bacillus psittacosis*. The material from this parrot was used to inoculate another parrot and the latter died with the same disease picture as that found in the first parrot.

Confirming the reports of investigations made elsewhere Doctor Krumwiede found that the infectious agent causing the disease was apparently very minute in size, for it could be filtered through a Berkefeld V filter and still remain capable of producing the disease in other parrots. Doctor Krumwiede and his staff, Miss Mary McGrath and Miss Caroline Oldenbusch, have been able to pass this virus through three series of parrots.

The relationship of this virus to the disease in humans is further confirmed by the fact that material obtained from the human patients when inoculated into healthy parrots caused death of the birds with the same clinical picture as that found in parrots inoculated with material from the sick parrot first sent to the laboratory. This human material appears to contain the same very minute microorganism, because it, too, can be filtered through a Berkefeld V filter and still cause death in parrots inoculated with the filtrate.

An interesting feature of Doctor Krumwiede's work is the fact that mice are susceptible to the virus. The material from the parrot associated with the two ill persons was inoculated into mice and some of these died. After several passages in mice the material was used to inoculate a healthy parrot; this parrot died. The material from this parrot killed mice. In none of these cases was the *Bacillus psittacosis* found, so that the evidence indicates that the virus producing the so-called parrot disease belongs to the so-called filterable group.

Thus far the workers at the research laboratory have been unable to produce the disease in monkeys.

The greatest care has been taken to avoid picking up a virus native to the experimental animals. This possibility has been excluded as far as possible by using healthy parrots from sources free from disease and parrots which were imported some time before the present outbreak of parrot disease occurred.

Commenting on the findings of Bedson, Western, and Simpson, reported in the February 1 issue of the London Lancet, Doctor Krumwiede notes that the findings of these scientists are similar to those obtained by himself and his colleagues. The suggestion made

by the English observers that the virus of parrot disease is like that of fowl plague does not accord with Doctor Krumwiede's inability to cause disease in hens.

Doctor Krumwiede's experiences with the virus of fowl plague has shown an extraordinarily high virulence of this virus for hens. Krumwiede's studies indicate that pigeons are also immune to the virus of parrot disease.

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#### HEALTH OF THE NAVY

The general admission rate, all causes, based on returns for October, November, and December, 1929, was 665 per 1,000 per annum as compared with 549, the rate for the corresponding months of 1928. The median rate for the fourth quarter, as indicated by the records of the preceding five years, is 529.

The admission rate from disease was 611 per 1,000 per annum as compared with 459, the 5-year median for the corresponding three months. The admission rate from accidental injuries was 54. The median or expected rate for the corresponding quarter of the preceding five years is 69.

Acute respiratory diseases, in general, were not more prevalent than expected. A total of 1,559 cases of these diseases was reported by shore stations during the quarter of which 659 were notified in December. Of the 446 cases of catarrhal fever reported during the quarter by the United States naval training station, Great Lakes, Ill., 211 occurred in December. That excellent health conditions existed at the United States naval training station, Hampton Roads, Va., is reflected by the fact that but 22 cases of catarrhal fever were admitted during the time period under consideration.

Six nonfatal cases of cerebrospinal fever were reported as follows: The United States naval training station, San Diego, Calif., 1 case in October and another in December; United States naval air station, San Diego, Calif., 1 case in December; United States naval training station, Hampton Roads, Va., 2 cases in December; and the United States naval training station, Newport, R. I., 1 case in November.

Cases of diphtheria were reported by shore stations, as follows: United States naval station, Key West, Fla., one in October; and the United States marine barracks, Washington, D. C., one in November.

The naval air station, San Diego, Calif., reported one case of scarlet fever in December, and the United States navy yard, Mare Island, Calif., another case during the same month.

One case of typhoid fever was reported by headquarters, third naval district, New York, N. Y., in October, and one case of paratyphoid fever "A" by the naval air station, Pensacola, Fla., also in October.

The admission rate, all causes, for forces afloat was 552 per 1,000 per annum. The median for the fourth quarter of the preceding five years is 464. The U. S. S. *Maryland* reported one case of typhoid fever in October. Two cases of paratyphoid fever were reported in October, one by the U. S. S. *Jason* and the other by the U. S. S. *Pittsburgh*. The patient in the latter case died. The U. S. S. *Pittsburgh* also reported one case of scarlet fever in October and one case of diphtheria in December. Five other cases of scarlet fever were notified in December, as follows: U. S. S. *Lexington*, 2; U. S. S. *Oklahoma*, 1; U. S. S. *Reno*, 1; and U. S. S. *Williamson*, 1.

In December two cases of cerebrospinal fever were reported, one by the U. S. S. *Medusa* and the other by the U. S. S. *Tulsa*.

TABLE NO. 1.—Summary of morbidity in the United States Navy and Marine Corps for the quarter ended December 31, 1929

	Forces afloat	Forces ashore	Marine Corps	Entire Navy
Average strength.....	75, 274	41, 141	19, 276	116, 415
All causes:				
Number of admissions.....	10, 395	8, 980	3, 796	19, 375
Annual rate per 1,000.....	552. 38	873. 09	787. 72	665. 72
Disease only:				
Number of admissions.....	9, 438	8, 336	3, 559	17, 774
Annual rate per 1,000.....	501. 53	810. 48	738. 53	610. 71
Communicable diseases, exclusive of venereal diseases:				
Number of admissions.....	1, 950	3, 151	1, 101	5, 101
Annual rate per 1,000.....	103. 62	306. 36	228. 47	175. 27
Venereal diseases:				
Number of admissions.....	3, 279	1, 248	822	4, 527
Annual rate per 1,000.....	174. 24	121. 34	170. 57	155. 55
Injuries:				
Number of admissions.....	928	636	235	1, 564
Annual rate per 1,000.....	49. 31	61. 84	48. 77	53. 74
Poisoning:				
Number of admissions.....	29	8	2	37
Annual rate per 1,000.....	1. 54	. 78	. 42	1. 27

TABLE NO. 2.—Deaths reported, entire Navy, during the quarter ended December 31, 1929

	Navy			Marine Corps		Nurse Corps	Total
	Officers	Midshipmen	Men	Officers	Men		
Average strength.....	8, 824	1, 998	85, 818	1, 191	18, 086	498	116, 415
CAUSE: DISEASES							
	Primary	Secondary or contributory					
Abscess, brain.....	None.....	1					
Abscess, hand.....	Septicemia.....	1					
Abscess, skin and subcutaneous tissues.....	do.....	1					
Alcoholism, acute.....	None.....	1					
Alcoholism, chronic.....	do.....	1					
Arteriosclerosis, general.....	do.....	1					
Blasromycesis, lung torula.....	Encephalitis, torula.....	1					
Carcinoma, rectum.....	Metastasis, liver pancreas and omentum.....	1					

TABLE NO. 2.—Deaths reported, entire Navy, during the quarter ended December 31, 1929—Continued

		Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
Average strength.....		8,824	1,998	85,818	1,191	18,086	498	116,415
CAUSE: DISEASES—Continued								
Primary	Secondary or contributory							
Carcinoma, rectum and lower sigmoid.	None.....			1				1
Cellulitis, left supraorbital region.	Meningitis, cerebral.....			1				1
Cholecystitis, acute.....	Peritonitis, acute.....	1						1
Dysentery, entamebic.....	Gangrene, infection.....					1		1
Encephalitis.....	None.....			1				1
Lymphosarcoma mediastinal lymph nodes.	Metastases, lung, liver, and skull.....					1		1
Myelomata, multiple, sternum, ribs, vertebrae, and skull.	Pneumonia, broncho.....	1						1
Myocarditis, chronic.....	do.....				1			1
Nephritis, chronic.....	None.....					1		1
Do.....	Hemorrhage, cerebral.....			1				1
Obstruction, intestinal from external cause.	Peritonitis, local acute.....			1				1
Paratyphoid fever.....	Pneumonia, lobar.....			1				1
Pemphigus.....	Pneumonia, broncho.....					1		1
Pneumonia, lobar.....	None.....	1		1		2		4
Psychosis, unclassified.....	do.....			1				1
Sarcoma, right femoral glands, mediastinum, and right chest.	do.....			1				1
Syphilis.....	Nephritis, chronic.....			1				1
Tonsillitis, acute.....	Pneumonia, lobar.....			1				1
Do.....	Septicemia.....			1				1
Tuberculosis, chronic, pulmonary.	None.....			3		1		4
Do.....	Syphilis.....			1				1
Do.....	Tuberculosis, intestinal chronic.....			1				1
Tuberculosis, pulmonary, acute general miliary.	Tuberculosis, meningitis.....					1		1
Tuberculosis, general miliary.	Peritonitis, general acute.....			1				1
Valvular heart disease, combined lesions, aortic and mitral.	Endocarditis, acute.....			1				1
Total for diseases.....		3		23	1	12		39
CAUSE: INJURIES AND POISONING								
Primary	Secondary or contributory							
Asphyxiation, illuminating gas	None.....			1				1
Crush, skull.....	do.....			1				1
Drowning.....	do.....	1				1		4
Fracture, compound skull.....	Hemorrhage, intracranial.....			2				2
Fracture, simple.....	None.....			1				1
Do.....	Laceration, head and body.....			1				1
Intracranial injury.....	None.....			1				1
Do.....	Alcoholism, acute.....			1				1
Do.....	Hemorrhage, traumatic intracranial.....			2				2
Intraspinal injury.....	None.....			1				1
Do.....	Dislocation, cervical vertebrae.....			1				1
Injuries, multiple extreme.....	None.....	1		6			2	9

TABLE NO. 2.—Deaths reported, entire Navy, during the quarter ended December 31, 1929—Continued

		Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
Average strength.....		8,824	1,998	85,818	1,191	18,086	498	116,415
CAUSE: INJURIES AND POISONING—Continued								
Primary	Secondary or contributory							
Landplane crash: Injuries multiple extreme.	None.....	1						1
Wound, gunshot, brain	do.....			1				1
Wound, gunshot, abdomen, and arm.	do.....						1	1
Wound, incised, head, chest, left leg, and both arms.	Hemorrhage, traumatic and shock.					1		1
Wound, incised right and left side of neck.	Psychoneurosis neurasthenia.	1						1
Wound, penetrating brain	None.....			1			1	2
Do.....	Dementia præcox.....			1			1	2
Poisoning, acute carbon monoxide gas.		1		1				2
Total for injuries and poisoning.....		5		24	1	6		36
Grand total.....		8		47	2	18		75
Annual death rate per 1,000:								
All causes.....		3.63		2.19	6.72	3.98		2.58
Disease only.....		1.36		1.07	3.36	2.65		1.34
Drowning.....		.45		.09		.22		.14
Injuries.....		1.36		.98	3.36	1.11		1.03
Poisoning.....		.45		.05				.07

STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by naval training stations:

Cumulative data	Number	Per cent of recruits received	Per cent of recruits reviewed
Jan 1. to Dec. 31, 1928 (all naval training stations):			
Recruits received during the period.....	13,589		
Recruits appearing before board of medical survey.....	611	5.50	
Recruits recommended for discharge from the service.....	410	3.02	67.10
October, November, and December, 1929 (United States naval training station, Hampton Roads, Va.):			
Recruits received during the period.....	755		
Recruits appearing before board of medical survey.....	39	6.17	
Recruits recommended for discharge from the service.....	22	2.91	56.41
United States naval training station, Great Lakes, Ill.:			
Recruits received during the period.....	1,122		
Recruits appearing before board of medical survey.....	107	9.54	
Recruits recommended for discharge from the service.....	75	6.68	70.09
United States naval training station, San Diego, Calif.:			
Recruits received during the period.....	1,448		
Recruits appearing before board of medical survey.....	14	.97	
Recruits recommended for discharge from the service.....	14	.97	100.00
United States naval training station, Newport, R. I.:			
Recruits received during the period.....	733		
Recruits appearing before board of medical survey.....	213	29.06	
Recruits recommended for discharge from the service.....	26	3.55	12.21

The following cases, selected from reports of medical survey recently received by the bureau, are presented to indicate conditions existing prior to enlistment which led to early separation from the service. These conditions were so evident that the men should have been rejected at their respective recruiting stations.

The men, in the following cases, were all apprentice seamen with less than one month's service. Physical defects responsible for their discharge from the Navy were discovered when they were re-examined at a naval training station within a few days after they were enlisted.

*Dental defects.*—The following three cases were selected from the records of 43 men who were surveyed between December 6, 1929, and March 5, 1930, within a few days after they were enlisted because of dental defects.

Enlisted at Salt Lake City, Utah, December 5, 1929. He was found to be suffering with Vincent's angina, apparently of long standing. There were many deep pockets with loss of supporting tissue about the teeth, all of which were loose. Surveyed December 17, 1929.

Enlisted at Detroit, Mich., December 26, 1929. Teeth Nos. 1, 4, 11, 12, 16, 17, 32, were missing and Nos. 2, 5, 13, 14, 15, 18, 20, 27, 30, 31, were carious. All teeth were generally unsound due probably to disturbances of metabolism in early life which resulted in faulty calcification. Surveyed December 26, 1929.

Enlisted at Cincinnati, Ohio, February 1, 1930. The oral cavity was in very poor condition. He had an extensive pyorrhea alveolaris. Teeth Nos. 1, 7, 12, 13, 14, 15, 16, 18, 29, 30, and 32 were carious. Education corresponded to that of the sixth grade. Surveyed February 4, 1930.

*Chronic otitis media.*—Enlisted at Pittsburgh, Pa., December 4, 1929. History of an abscess, right ear, six months before. Both external auditory canals were filled with cerumen which was removed at a training station. A large calcareous deposit covered the left ear drum. The right drum was perforated and showed evidence of chronic irritation. Surveyed December 10, 1929.

Enlisted at New Haven, Conn., February 17, 1930. History of ear trouble following an attack of diphtheria seven years before. Examination revealed deafness of the right ear. There was a perforation of the right drum with evidence of a chronic discharge. Surveyed February 28, 1930.

*Organic heart disease.*—Enlisted at Detroit, Mich., December 6, 1929. Examination disclosed a forcible apex beat, slight cardiac enlargement, accentuation of the pulmonic second sound, and a soft systolic murmur, blowing in character, which was increased after exercise and which was transmitted to the axilla. The heart's action was slightly irregular. Surveyed December 10, 1929.

Enlisted at Kansas City, Mo., February 10, 1930. Upon examination he was found to have both systolic and diastolic heart murmurs. There was an aortic regurgitant murmur, churning in character, of low pitch with greatest intensity over the base of the heart. There was also a systolic mitral regurgitant murmur which was heard best over the apex and which was transmitted to the left axilla and the inferior angle of the scapula. A capillary pulse could be easily elicited in the lips and under the fingernails. Surveyed March 6, 1930.

*Tachycardia.*—Enlisted at Milwaukee, Wis., January 8, 1930. At rest the pulse rate was about 150 beats per minute and after exercise about 175. Slight exophthalmos, tremors of the fingers, and increased ocular tension were also noted. Surveyed January 13, 1930.

*Chronic nephritis.*—Enlisted at Dallas, Tex., December 6, 1929. Urinalysis showed a large quantity of albumin, many hyaline and granular casts, pus cells, and red blood cells. Edema below the lower lids was observed. Rest in bed for a period of 10 days resulted in no improvement. Surveyed December 20, 1929.

Enlisted at Little Rock, Ark., December 12, 1929. This man had never enjoyed good health. According to the history, he had typhoid fever, measles, and scarlet fever when he was 8 years of age. His ailments had existed four years. Physical examination revealed tachycardia, with a pulse rate of 108. The apex beat was 1 centimeter to the left of the nipple line and the radial arteries were slightly fibrosed. Blood pressure was 160/80. His teeth did not come within the dental requirements. Urinalysis on five consecutive days showed a definite trace of albumin, much mucus, a number of red blood cells, a few finely granular and many hyaline casts. Surveyed December 23, 1929.

*Visual defects.*—Enlisted at Albany, N. Y., December 17, 1929. Vision of the right eye was 20/70 and of the left eye 20/100. Surveyed December 30, 1929.

Enlisted St. Louis, Mo., December 31, 1929. Vision of the left eye was 5/20. Examination of the eye ground revealed atrophy of the temporal half of the nerve head and small areas of chorioretinitis. Surveyed January 6, 1930.

*Color blindness.*—Enlisted at Birmingham, Ala., December 30, 1929. He failed entirely to read the numbers on the Stilling test plates, could not match the yarn skeins and could name no colors correctly. He was red and green color-blind and was poor in differentiating all colors. The right testicle was enlarged and tender as a result of an injury sustained about four years before. He also had depressed arches and chronically diseased tonsils. Surveyed January 3, 1930.

*Deformity.*—Enlisted San Francisco, Calif., December 19, 1929. Upon examination this man was found to have a circular, depressed, pulsating scar tender to pressure and about 1 inch in diameter in the left frontal bone. The defect was caused by a wound from a pistol bullet and subsequent operation for its removal. Surveyed January 6, 1930.

Enlisted at Little Rock, Ark., March 3, 1930. Knock knees in this case would not permit the man to drill or to perform successfully the required routine duties. He also had relaxed inguinal rings and chronically diseased tonsils. Surveyed March 7, 1930.

Enlisted at Louisville, Ky., February 13, 1930. Due to an injury received about a year before, this man had a deformity of the right forearm which seriously interfered with pronation and supination. He was surveyed the day after he enlisted.

*Flat feet.*—Enlisted at Louisville, Ky., December 12, 1929. He had decidedly flat feet associated with pain after standing for any considerable period of time. Surveyed December 19, 1929.

Enlisted at Brooklyn, N. Y., March 3, 1930. The arches of both feet were very depressed. In addition he had bilateral bunions and a small umbilical hernia. Surveyed March 10, 1930.

*Cicatrix of skin.*—Enlisted at Brooklyn, N. Y., March 3, 1930. Operation for a ruptured appendix had been performed in 1923. He had a scar 7 inches long and 4 inches wide with considerable adhesion of underlying tissues. Surveyed March 10, 1930.

*Hernia.*—Enlisted at Philadelphia, March 5, 1930. Examination disclosed a right inguinal hernia which gave an impulse on coughing. He also had chronically diseased tonsils and a deviation of the nasal septum with obstruction. He was surveyed two days later.

*Constitutional inferiority.*—Enlisted at Albany, N. Y., February 15, 1930. This recruit had an unusually poor physique with marked curvature of the spine, a presystolic heart murmur and a phthisical chest. Many dry râles were found throughout both apices and at the base of the right lung. Surveyed February 28, 1930.

*Stammering.*—Enlisted at Chicago, Ill., January 13, 1930. He had a pronounced impediment of speech which was increased under excitement. He also had an enlarged thyroid gland and stated that his brother had been rejected on account of a goiter. Surveyed January 15, 1930.

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#### ADMISSIONS FOR INJURIES AND POISONING, FOURTH QUARTER, 1929

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the fourth quarter, 1929, is based upon all Form F cards covering admissions in those months, which have reached the bureau:



	Admissions, October, November, and De- cember, 1929	Admission rate per 100,000 per annum	Admission rate per 100,000, year 1928
<b>INJURIES</b>			
Connected with work or drill.....	688	2,364	2,852
Occurring within command but not associated with work.....	519	1,783	1,855
Incurred on leave or liberty or while absent without leave.....	357	1,227	1,139
All injuries.....	1,564	5,374	5,846
Industrial poisoning.....	19	65	27
Occurring within command but not connected with work.....	11	38	125
Associated with leave, liberty, or absence without leave.....	7	24	42
Poisoning, all forms.....	37	127	194
Total injuries and poisoning.....	1,601	5,501	6,040

*Percentage relationships*

	Occurring within command				Occurring outside command: Leave, liberty, or absent without leave	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty			
	October, November, and December, 1929	Year 1928	October, November, and December, 1929	Year 1928	October, November, and December, 1929	Year 1928
Per cent of all injuries.....	44.0	48.8	33.1	31.7	22.8	19.5
Per cent of poisonings.....	51.4	13.8	29.7	64.4	18.9	21.8
Per cent of total admissions, injury, and poisoning titles.....	44.1	47.7	33.1	32.8	22.7	19.5

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug Addiction" or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from October, November, and December, 1929, reports, are worthy of notice from the standpoint of accident prevention:

*Hatchway hazards.*—A gunner's mate, first class, stepped on a broken rung and fell while descending a ladder aboard ship. He sustained a lacerated wound of the shin. Loss of time, 78 days, 68 of which were hospital days.

A seaman, second class, fell through a hatch which was left open and unguarded by an unknown person. He received fractures of the left tibia and fibula. Loss of time, 162 days in hospital.

A storekeeper, second class, fell through an open hatch which, due to the negligence of others, was not properly guarded. He suffered simple fractures of the occipital bone and eighth dorsal vertebra. Loss of time, 188 days in hospital.

*Hatch-cover hazards.*—The hook securing a hatch cover became disengaged while a mess attendant, first class, was descending the ladder. His hand was crushed between the hatch combing and the

falling cover. He sustained compound fractures of all metacarpal bones of the right hand. He was treated in hospital for 190 days.

*Dangerous practice—Gasoline and cigarettes.*—A bucket containing gasoline was carelessly left unprotected on deck aboard ship. An unknown person added a lighted cigarette. The gasoline exploded. In attempting to extinguish the fire, a boatswain's mate, second class, received extensive burns of the hands and leg. Loss of time, 156 sick days.

A marine private, while at work, accidentally spilled gasoline on his trousers. He lit a cigarette. Injury, extensive burn of the leg. Loss of time, 108 days in hospital. He was still under treatment at the end of the year.

*Dangerous practice with gasoline.*—A marine private on outpost duty in Nicaragua while throwing gasoline on a fire in the open accidentally spilled some of the liquid on his clothes. Injury, multiple burns of the chest, neck, and arms. Loss of time, 62 sick days.

*Dangerous practice with old crankcase oil.*—A seaman, first class, cast some old crankcase oil into a coal stove under the impression that the fire was out. It was not. He received burns of the chest in the resulting flareback. Loss of time, 19 sick days.

*Careless handling of firearms.*—A service revolver was accidentally discharged in the hands of a marine private who was cleaning the weapon. He received a wound of the left hand and was incapacitated for 43 days. Existing orders require that all firearms be carefully inspected before cleaning and all cartridges removed.

In direct violation of the above orders, a marine private preparing to clean a rifle rested the muzzle on his instep. The rifle, which was loaded and cocked, was discharged in some unknown way, inflicting a punctured wound of the left foot. Some of the bullet fragments could not be removed. He was subsequently invalided from the service. Loss of time, 130 days, 42 of which were spent in hospital.

*Unsafe practice—Cartridges and incinerator.*—Several 30-caliber cartridges were thrown into the incinerator of a ship by an unknown person. In the resulting explosion a seaman, first class, received a lacerated wound of the axillary region, and another seaman a lacerated wound of the left arm and thigh. Loss of time on a hospital ship was 34 and 33 days, respectively.

*Unsafe practice—Power-driven machine hazards.*—An engineman, second class, rested his left foot on the wheel of a lathe while reading during the noon hour. Another man accidentally started the machine. The former suffered simple fractures of the first, second, and third metatarsal bones and spent 94 days in hospital.

A marine private was using his fingers to force meat into a grinder. His hand was caught in the machine. Result, amputation right index finger. Loss of time, 30 sick days in hospital.

While another marine private was working at a wringer in a post laundry the brake ceased to function. In attempting to adjust the attachment without shutting off the power, his hand was caught between the rollers. Result, fracture of the styloid process of the ulna. He was invalided from the service after 92 days in hospital.

*Small-boat hazards.*—Due to his own negligence a seaman, first class, placed his left hand on the gunwale of a small boat. A wave forced the gunwale under a scupper tip causing traumatic amputation of the distal phalanx of the middle finger. Loss of time, 25 days.

*Unsafe practice—Gangway not properly secured.*—A gangway which was not properly secured fell while a chief electrician's mate was going aboard ship. He was thrown to the deck and received a simple fracture of the left tibia. After 207 days on the sick list he was still under treatment at the end of the year.

*Defective awning.*—In attempting to secure an awning he was rigging, a seaman, first class, fell against a piece of timber when the stop parted. The awning was reported as old and worn. He suffered simple fractures of the third and fourth lumbar vertebræ. Loss of time, 12 hospital days.

*Unsafe practice—Deck chest not secured.*—A chief boatswain's mate was injured by a chest which was carried across the deck by a heavy sea. The chest was not secured. He received a fracture of the fibula. Loss of time, 69 days, of which 62 were spent in hospital.

*Unsafe practice—Life line not properly secured.*—A seaman, first class, who was chipping paint, slipped through a life line and fell from the staging to the bottom of the dry dock. The loop about his waist was not properly secured. He sustained extreme multiple injuries and was transferred to hospital where he remained under treatment at the end of the year after 206 sick days.

*Flying particles—Lack of eye protection.*—A flying particle lodged in the left eye of a seaman, first class, who was chipping steel with hand tools without wearing protective goggles. He suffered enucleation of the eye and was invalided from the service after 67 hospital days.

*Unsafe practice with a knife.*—A ship's cook, second class, accidentally severed a tendon of his right little finger. He was using a knife as an ice pick. Loss of time, 43 days in hospital.

*Skylarking.*—While skylarking an apprentice seaman received a contusion of the left eyeball from a paper wad projected from a rubber band in the hands of another man. A traumatic hemorrhage developed. He was invalided from the service after 114 hospital days.



# UNITED STATES NAVAL MEDICAL BULLETIN

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*Edited by*

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TRUMAN H. NEWBERRY,  
*Acting Secretary.*

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## PREFACE

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The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April, 1907, as means of supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes, and comments on topics of medical interest, and reviews or notices of the latest published medical books.

The bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of commendation to authors of papers of outstanding merit and will recommend that copies of such letters be made a part of the official records of the officers concerned.

The bureau does not necessarily undertake to indorse all views or opinions which may be expressed in the pages of this publication.

C. E. RIGGS,  
*Surgeon General United States Navy.*

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# U. S. NAVAL MEDICAL BULLETIN

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## SPECIAL ARTICLES

### **A MOBILE BATTALION AID STATION EQUIPMENT FOR USE WITH UNITED STATES MARINE CORPS EXPEDITIONARY FORCES**

By W. M. GARTON, Captain, Medical Corps, United States Navy, and R. G. HEINER, Captain, Medical Corps, United States Navy

The circumstances under which expeditionary forces are compelled to operate necessitate an equipment which will meet a wide variety of conditions and yet be neither bulky, heavy, nor unwieldy. The principle of making each item serve as many purposes as possible should be carried out to the fullest extent.

A battalion aid station, in addition to rendering first aid, must provide transportation from the firing line and should give some shelter from the weather. Drinking water must be provided.

There are times, under conditions of battle, when all equipment, except firearms, has to be abandoned. However, all equipment which can be used to advantage is brought as far to the front as possible. As an example, machine guns are carried on wheels (Cole carts) until the carts have to be abandoned and the guns carried by hand.

In looking for a method of transportation for the medical battalion outfit, standard equipment was first tried out and after considering the Marine Corps machine-gun cart (Cole cart) it was decided that on account of its strength, lightness in weight, and adaptability, it would serve the purpose admirably.

It was found that three of these Cole carts would carry the equipment needed for a battalion aid station and that two men to each cart could wheel this equipment at the required rate of speed over a fairly rough terrain.

The standard medical expeditionary equipment for a battalion aid station is used as a basis for this mobile outfit and no claim is made for the addition of any essential items. However, on account of the compactness of this assembly and its mobility on the standard Marine Corps machine-gun carts (Cole carts) it has been made

possible to add certain desirable items, namely, a tent, a wheelbarrow type and a 2-wheeled type litter, and two folding horses to make a table, using a litter as the top, and to release three litters which were formerly used to make a tripod to hold the Lister bag.

The advantages gained are ease of transportation and the addition of several desirable items—wheel litters, tents, and horses for a table. These items are added with less than 25 per cent increase in weight.

The advantage of the wheel litter is very evident when it is considered that the lowering and lifting of the Army litter at intervals to rest or change position requires an expenditure of considerable energy. Two litter bearers using the regular Army litter can carry a man only at a slow pace and a limited distance.

In the development of a practical wheel litter, the first aim was to avoid all unnecessary lifting and lowering; movable legs capable of being trussed up when in motion and let down when resting were given a test. The second step taken was to build a wheel litter of light weight, utilizing two rubber-tired wheels from an invalid chair and making a frame to hold them securely to the middle of the litter.

This litter was used in drills and maneuvers at Quantico and greatly facilitated the transportation of men, saving the time and strength of the litter bearers. When resting it was unnecessary to lower and lift the litter, and when the terrain was favorable the patient could be wheeled.

In order to make a more stable wheel litter, two small aviation wheels were substituted for the two invalid-chair wheels. For the sake of convenience in transportation, the frame was so constructed as to be movable and capable of being packed. The wheels of the Cole cart were first considered, but those of an airplane were finally selected.

To reduce still further the weight and the number of brackets and wheels to be transported, a design was made whereby one aviation wheel was attached to the center of the litter by detachable steel brackets. In the 2-wheel construction it was necessary to place one leg at each end, midway between the handles, to balance the litter properly when not supported by the litter bearers; while in the 1-wheel litter two supports were necessary at each end for this purpose.

To reduce the number of supports, it seemed best to apply the wheelbarrow principle and change the wheel position toward one end, which necessitated only two legs similar to the legs of a wheelbarrow. This type was adopted on account of minimum equipment and the ease with which it can be assembled, and it was found to be very practicable. It is handled as follows: The forward litter

bearer assists the guiding and lifting when necessary and the litter bearer at the head end pushes—wheelbarrow fashion—when surface terrain is favorable. When terrain is not favorable for wheeling, the litter is carried by the litter bearers at each end, with the wheel off the ground.

The wheels used were taken from surveyed and condemned planes and the brackets to hold same to litter were made of aviation strut tubing with joints electrowelded. These are quite light but could be made lighter by using duralumin. The weight of the brackets and wheel for this wheelbarrow litter is 21 pounds. This equipment is detachable and goes in the equipment case on cart No. 1.

After the three Cole carts had been converted to carry the medical equipment and the whole outfit had been assembled, it was noted that two of the carts could be used, in the set-up, to hold the Lister bag, while the third one served no particular purpose. The idea then presented itself to utilize the third cart as a mobile litter carrier. All that was necessary to carry out this idea was to prepare four detachable supports. The Cole cart, as arranged with litter attached, makes a splendid 2-wheel litter. The weight of these supports is 2½ pounds. They take up a negligible space in the equipment case on cart No. 1.

The tent is a very desirable item although it requires, in addition to the canvas, sectional poles, tent pins, and mallet. The total weight is 55 pounds, which can be greatly reduced by replacing the present wooden poles and pins by light steel tubing.

The horses used for improvising an operating table, with a litter as the top, serve a double purpose since they are so arranged as to secure eight litters on the top of the equipment carried on carts No. 2 and No. 3. These racks are essential over rough terrain and it was only necessary to add two light folding legs to them to make them serve the purpose of table supports. The weight of the litter rack and table support is 18 pounds.

The standard medical expeditionary equipment for a battalion aid station can be carried on two Cole carts but in order to supplement this equipment with the other desirable, if not essential, items a third cart has to be used. This third cart is arranged to carry an equipment case holding the extra items. As the personnel of the battalion aid station includes at least six corps men and as each cart can be manned satisfactorily by two men the extra cart makes a more balanced organization.

The weight of the equipment case is 90 pounds, but could be much reduced by using steel or duraluminum. The weight of the Cole carts is 90 pounds each and the weight of items No. 5, No. 6, and No. 7 are 140, 133, and 60 pounds, respectively.

Practical demonstrations have proved the helpfulness of Cole carts in transporting the medical expeditionary equipment in the field and the use of these two designs of wheel litters in the transportation of wounded from the firing line.

For convenience of description and organization these carts are designated as "Battalion Aid Station Carts No. 1, No. 2, and No. 3."

Cart No. 1 carries, in equipment case, 1 tent fly, 2 sectional tent poles, 1 set of tent pins, 1 mallet, 1 lantern, 12 blankets, 1 Lister bag, 1 wheel and brackets to attach same to a standard Army type litter, and brackets to attach standard Army litter to Cole cart No. 3. This cart, in the set-up, helps to support the Lister bag.

Cart No. 2 carries standard Navy medical expeditionary equipment, items No. 5 and No. 7, rack for litters and four standard Army litters. This cart, in the set-up with cart No. 1, supports the Lister bag.

Cart No. 3 carries standard Navy medical expeditionary equipment, items No. 6 and No. 7, rack for litters and four standard Army litters. This cart, in the set-up, is converted into a 2-wheel litter by the attachment of an Army litter with the four supports carried in the equipment case on cart No. 1.

The total weight of cart and equipment is: Cart No. 1, 280 pounds; cart No. 2, 408 pounds; and cart No. 3, 401 pounds.

Extra items, including equipment case, carried on cart No. 1 can be materially reduced in weight by changes in design of case, poles, pins, etc., and using lighter material throughout. However, items carried on carts No. 2 and No. 3, except the 18-pound litter racks, are standard equipment which have been adopted after long usage and it is doubtful whether any changes with a view to reduction in weight would be advisable.

The whole outfit as outlined is not unwieldy and if the added items carried on cart No. 1 are made lighter and a rearrangement of loads to be carried on each cart is made to give a more even distribution of weight the outfit would be well balanced.

There is some question as to the necessity of carrying two items, No. 7 (battle dressings) or items No. 5 (medical aid chest). If both of these could be eliminated, the weight per cart would be relatively small. The standard Army litter weighs 25 pounds, which amounts to 200 pounds for the eight litters. A lighter design of litter would materially reduce the total weight.

A description of the following photographs will help in understanding the foregoing.

FIGURE No. 1. Carts No. 1, No. 2, and No. 3 packed ready to move with troops, with a personnel of two men to each cart.

FIGURE No. 2. Shows the one-wheel stretcher. Wheel and brackets to attach same to stretcher are carried in box on cart No. 1.

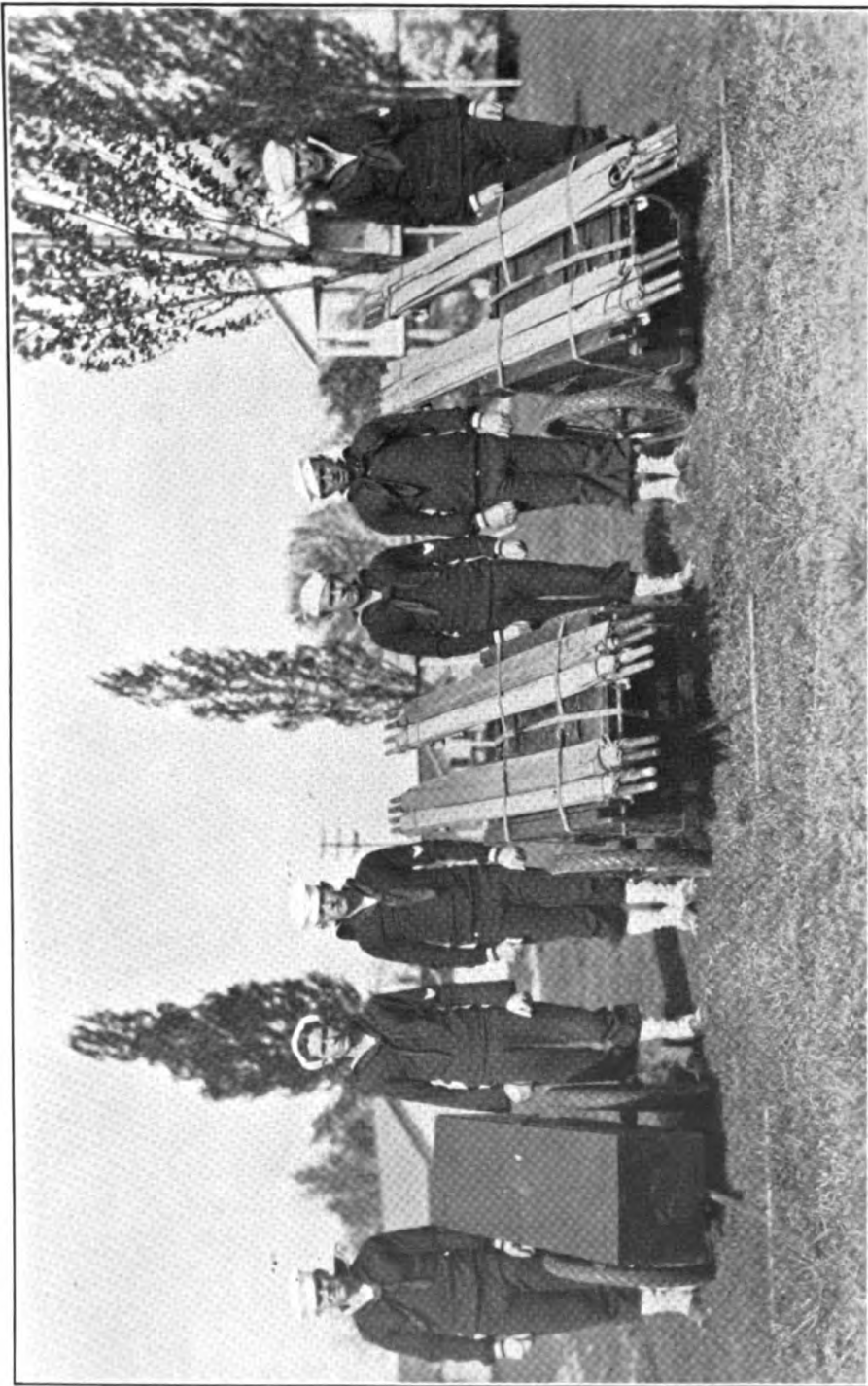


FIGURE 1.—COMPLETE EQUIPMENT FOR MOBILE BATTALION AID STATION ASSEMBLED ON COLE CARTS. (GARTON-HEINER)

714-1





FIGURE 2.—ONE-WHEEL STRETCHER. WHEEL AND BRACKETS TO ATTACH SAME TO STRETCHER CARRIED IN BOX ON CART NO. 1. (GARTON-HEINER)

714-2



In conclusion, this outfit is not crude, but, as stated, could be improved upon. It is mobile, strong, and compact, and the weight is not excessive for the number of men supposed to be available in a battalion aid station. It can be set up for action in less than five minutes. It has been well tried out in maneuvers at Quantico and has proven its value, and unless changes in standard expeditionary equipment are in order, little can be done to reduce its weight, beyond what has been suggested in regard to the equipment case, tent poles, and pins.

The blue print and photographs of this mobile expeditionary outfit were prepared by Lewis G. Cipolloni, Ph. M. lc., U. S. N.

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#### INTRAVENOUS UROGRAPHY WITH UROSELECTAN \*

By JOHN DUFF, M. D., Deputy Urologist, James Buchanan Brady Foundation of Urology of the New York Hospital

The synthesis of Uroselectan for intravenous urography must be regarded as the most important accomplishment of this decade in urology. The discovery of this substance was not an accident, but rather the successful termination of a carefully planned research. The problem was to find a nontoxic drug which, when introduced into the blood stream, would be excreted by the kidneys in sufficient concentration to cast a radiographic shadow, thereby visualizing the urinary tract. Suffice it to say, but not to minimize in any way the efforts of Binz, Swick, Heckenbeck, and Hughes, the problem was recently solved in Professor von Lichtenberg's clinic, St. Hedwig's Krankenhaus, Berlin, Germany. It seems quite fitting that this should be so, as mechanical or instrumental pyelography was originally introduced by von Lichtenberg and Vlocker in 1905, a quarter of a century ago.

Uroselectan contains 42 per cent of organically combined iodine, and the formula is that of a sodium salt—2-oxy-5-iodopyridin-N-acetic acid. It is freely soluble in water and when injected intravenously is excreted by a functioning kidney in sufficient concentration to give contrast on an X-ray film. No attempt will be made in this paper to discuss in detail the chemistry of Uroselectan. The fact remains that at last we have a satisfactory substance for intravenous administration, which, when excreted by the kidney, casts an appreciable radiographic shadow.

Visualization of the urinary tract may now be accomplished mechanically or physiologically, but whether one or both methods should be used depends upon a careful consideration of all the facts

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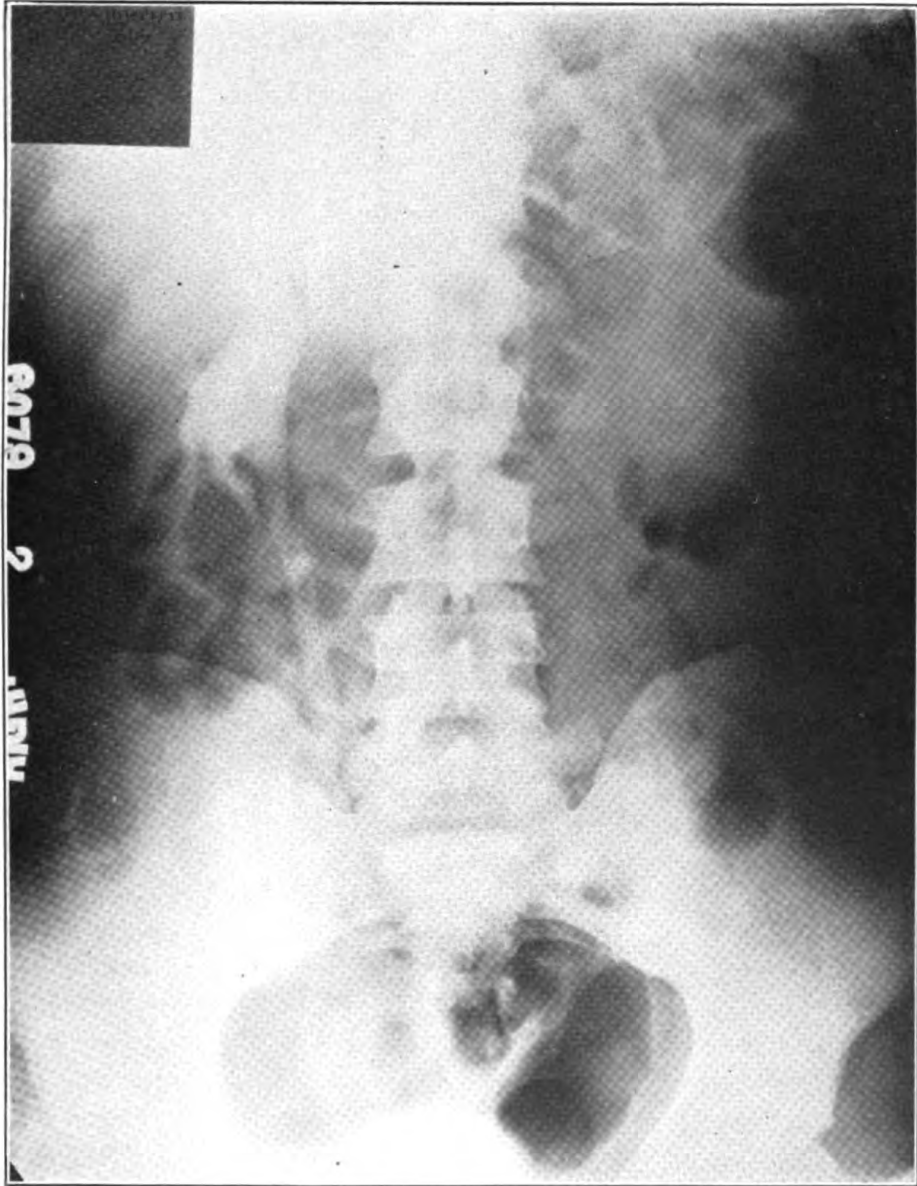
\*A lecture delivered at the United States Navy Medical School, Washington, D. C., June 16, 1930.

at hand. If we use Uroselectan intravenously and take roentgenological advantage of its excretion by the kidneys we will obtain a more nearly anatomically correct picture of the pathological and physiological condition of the urinary tract than if we mechanically inject an opaque substance under pressure into the ureters and pelves of the kidneys. However, physiological intravenous urography will never replace mechanical urography because when there is no kidney function Uroselectan is not excreted, and therefore a definite diagnosis of the pathology present can not be made. Uroselectan, however, does not give the accuracy and clearness of detail in filling defects and outline as does sodium iodide injected through ureteral catheters. Moreover, Uroselectan is expensive, and many films and much time must be expended in each case.

Uroselectan is particularly valuable when there is partial or complete obstruction of the ureter due to stone, stricture, or tumor. Its contrasting shadow on the film is then quite dense due to the mechanical retention and concentration of the substance. In many cases of marked hypertrophy of the prostate with intravesicle intrusion, a stricture of the urethra and severe cystitis, intravenous pyelography is a welcome procedure. We know that all unnecessary instrumentation should be avoided in cases of tuberculosis of the urinary tract. Therefore, intravenous Uroselectan is the method of choice when the diagnosis has been established. The urologist will likewise find it most satisfactory when a complete examination of an hysterical adult or nervous child is indicated. Uroselectan is not an infallible urological oracle, but rather a welcome addition to our diagnostic armamentarium.

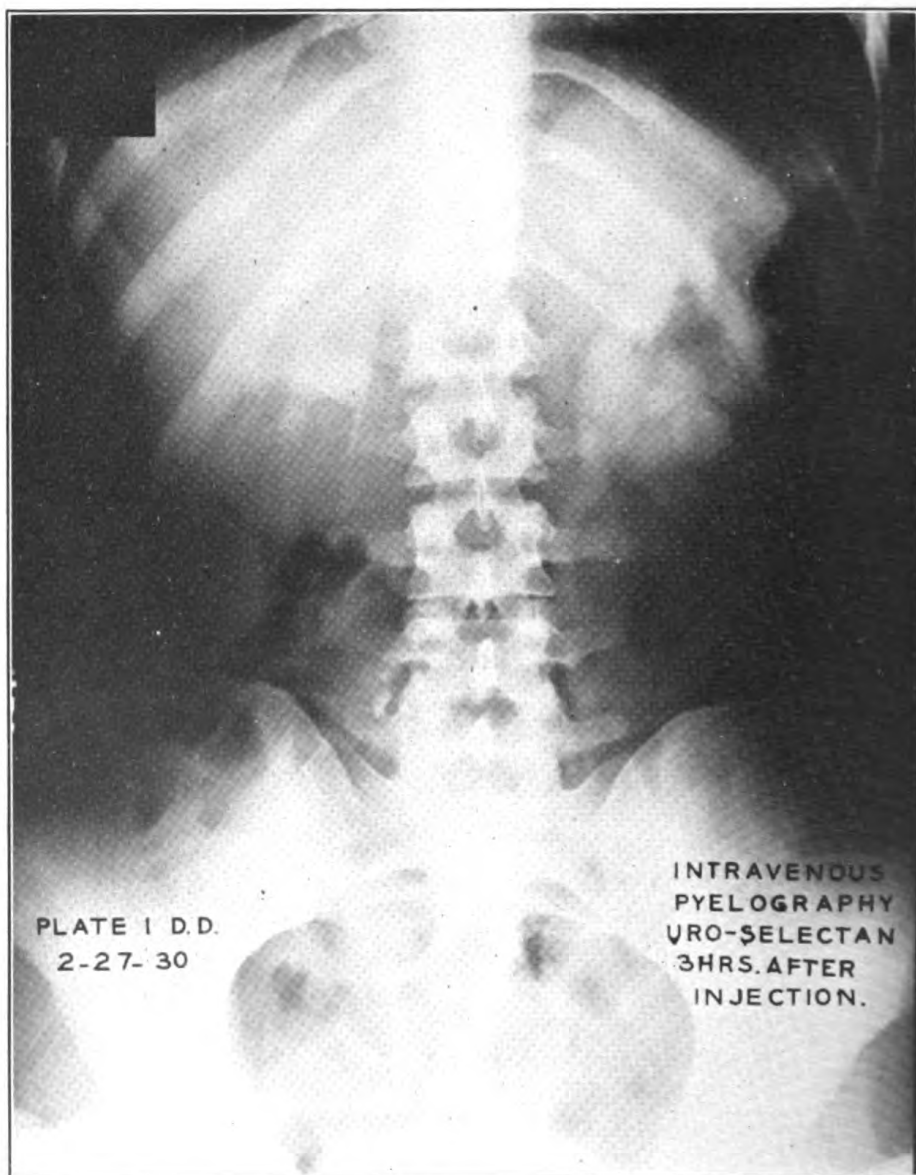
Von Lichtenberg states that by considering the appearance time, the intensity of the shadow, the quantity excreted in the urine, the specific gravity of the urine, the iodine content of the urine, and the retention of the substance in the blood a fair idea of kidney function can be obtained. He apparently is of the opinion, however, that much work is yet to be done before intravenous Uroselectan may be regarded as a practical test for kidney function. Incidentally, Swick and Heckenbeck, von Lichtenberg says, found that 90 per cent of the injected quantity is eliminated by the kidneys—most of it during the first two hours. Ureteral catheterization with collection of a urine specimen from each kidney for urea estimation; the subsequent intravenous injection of Phenol sulphone phthalein and its percentage determined in the separate specimens, will for some time to come be the most reliable method of determining the function of each kidney.

The preparation of the solution for intravenous injection is very simple. Double distilled water should be used. While the contents



TOTAL DESTRUCTION OF THE LEFT KIDNEY. NO UROSELECTAN SHADOW ON THE LEFT. SATISFACTORY PYELOGRAM AND URETEROGRAM VERY CLEARLY SHOWN ON THE RIGHT

716-1



UROSELECTAN SHOWS MARKED TUBERCULOUS INVOLVEMENT OF THE LEFT KIDNEY AND URETER

716-2

of the original bottle (40 grams) are being slowly poured into 120 c. c. of water it should be stirred diligently. When completely dissolved the solution should be filtered twice through a fine filter paper and boiled for 20 minutes, allowed to cool to body temperature (almost 100 c. c. will remain) and injected intravenously. We have found that the solution is fairly stable and may be kept in a refrigerator for 48 hours with very little impairment of its efficiency, although it is undoubtedly better to inject the fresh solution.

At the James Buchanan Brady Foundation of Urology of the New York Hospital we have had no serious reaction following the intravenous injection of Uroselectan. The patients usually state when questioned that they feel warm in some particular part of the body, occasionally they feel warm "all over." In two or three cases there was some nausea but no vomiting. One woman developed a slight cellulitis or phlebitis for a short distance along the vein which was injected, but her arm was very fat and the veins small. Last summer I spent several weeks in von Lichtenberg's clinic and saw no untoward results in over a hundred cases in which Uroselectan was used. He reported only last week at the meeting of the American Urological Association in New York, 700 cases with no serious or fatal results, although he does note 8 cases of phlebitis at the site of injection, evidence of the local inflammation appearing several days after the injection.

Binz ascribes this lack of toxicity to the fact that the iodine in Uroselectan is in an organically combined form which passes unchanged through the blood stream and is almost entirely excreted by the kidneys in the urine.

At the New York Hospital in the immediate past we have taken the first film in five minutes after the injection, the second in 15 minutes, the third in half an hour, the fourth in one hour, the fifth in two hours, and the sixth in three hours. This rather elaborate technique has been followed in order that nothing of interest might escape us, but lately it has been slightly modified. Von Lichtenberg recommends that the first film be taken in 15 minutes, the second in 45 minutes, and the third in 1½ hours. Our experience has been that in the average case the best picture is obtained in 30 minutes after injection.

It gives me pleasure to acknowledge the courtesy of Dr. Oswald S. Lowsley, director of the James Buchanan Brady Foundation of Urology of the New York Hospital, for permission to reproduce many of the films shown to-day.

**ANTIPENDULUM EXTENSION APPARATUS AND FRACTURE FRAME****APPARATUS DEvised TO OVERCOME HANDICAPS FOUND IN USE OF BALKAN FRAME  
AT SEA**

By C. M. SHAAR, Lieutenant, Medical Corps, United States Navy

In the fourteenth century, Guy de Chauliac recognized the difficulties incident to the proper management of fractures of the femur. He suspended fractures in a sling bandage and treated fractures of the femur by means of weight and pulley. Ambroise Paré, in the sixteenth century, gave a splendid description of a similar method and referred to it as his pulley. He also described the Glossocomium (a hoisting winch), the extension apparatus of the ancients. Fabricius Hildanus (1560-1634) secured a pulley to the foot of the bed and suspended a jackstone to the heel for continuous traction. The first recorded cases of using the weight and pulley method in America were by William C. Daniell, of Savannah, Ga. (1829), and L. A. Dugas, of Augusta, Ga. (1854). In 1861 Gurdon Buck perfected this method of traction and extension and made a report of 21 cases to the New York Academy of Medicine. The strong approval given by two great contemporaries, Samuel D. Gross and Lewis A. Stimson, made this method at once recognized throughout the world. To facilitate the use of weight and pulley for continuous traction and extension, various bed frames have been devised, the best known of which is the "Balkan frame."

Wijnen claims that Doctor Metz first used the frame in 1898 and described it in 1903. A Dutch ambulance unit brought it to Serbia, where it drew the attention of the French and Americans and was adopted under the name of the Balkan frame.

The Balkan frame was modified by Blake, Gasette, Desfosses, Charles-Robert, and Sinclair to answer any requirement in hospitals but not on hospital ships. The vibration, rolling, and pitching of a ship sets the extension weight attached to ice tongs, Steinmann pin, and other apparatus for traction into a pendulum motion which is very painful and annoying to patients and frequently destroys the purpose for which they are applied. Aboard the U. S. S. *Mercy* I was compelled to do two open reductions for this very reason. The writer used a spring scale to eliminate the pendulum motion caused by the suspended weight, but the vibration from the ship kept the spring in constant motion and the use of the scale did not overcome our handicap.

These problems prompted the writer to devise an extension apparatus and fracture frame to overcome the pendulum motion transmitted from extensive weight to fracture. By this procedure con-

servative methods may be used to equal advantage afloat and ashore. This method has been used successfully aboard both hospital ships of the United States Fleet. Commander R. Lanning, Medical Corps, United States Navy, appropriately called the apparatus the anti-jar swing. The importance of fracture treatment is emphasized when one considers the large number of officers and enlisted men with the fleet operating dangerous machinery and airplanes. To the number of fractures that result from such operations another large number must be added from athletics, automobile and motor-cycle accidents, occurring while the men are on liberty ashore. These fracture cases are sent to the hospital ship for treatment and remain on that vessel until they are able to return to duty. The hospital ship combines the functions of hospital and out-patient department. Therefore the number of sick days for a given fracture treated at sea appears to exceed those for a similar case treated ashore. This, however, is more apparent than real. In cases where the injury results in permanent disability or when a long period of convalescence is required to complete the treatment the patient is transferred to a naval hospital upon the return of the ship to one of the naval bases.

It is in fractures of the femur, humerus, tibia, and fibula, and sometimes the radius and ulna when traction and extension become necessary that conservative methods present serious handicaps at sea. Continuous traction by means of weight and pulley has been recognized as the most effective method for securing constant corrective extension in cases where the overriding persists. It is not the purpose of the anti-jar swing extension apparatus and fracture frame to change the technique of treating fractures, but to overcome a serious handicap on a hospital ship that operates with the fleet for long distances and at times in stormy weather and far from shore bases. Such an apparatus to be suitably adapted for use at sea should be anti-jar swing, compact, durable, simple in construction, inexpensive, and easily adjustable to meet any requirement. These specifications are all embodied in the frame, and its practicability and efficiency have been proven sufficiently to equip the hospital ship, U. S. S. *Relief*, with this apparatus. The U. S. S. *West Virginia* has also been recently equipped with the apparatus.

The fracture frame is made of metal tubing, either of iron or brass (fig. 1), which may be clamped to any bed or bunk. Through the metal tubing multiple fenestrations are made sufficiently large to admit a strong steel rod which may be secured by a thumbscrew at any desired length. The fenestrations are made in various directions so that any angle may be obtained. To the metal rod a pulley with a swivel is clamped at the required distance.

The anti-jar swing apparatus is an essential feature of the frame. Two types are required, one for the traction weights and the other

for weights suspended over the bed. The apparatus for traction consists of a square rod the upper end of which is curved to receive a pulley. A suitable clamp is applied to its shaft by means of which it can be secured to a bedstead or bunk. Immediately underneath the pulley is a small piece of metal tubing which is attached to the main rod by two small connecting rods. It is so constructed that the traction cord upon leaving the pulley can be passed down through the metal tube in a perfectly straight line. The weight is attached to the cord immediately after it emerges from the tube.

The purpose of the tube is to keep the traction cord in a straight line and to prevent the weight from being set in pendulum motion by the rolling and pitching of the ship at sea. A similar apparatus is secured to the other end of the bed for a counterextension weight. The antiswing apparatus used for weights suspended over the patient's bed consists of an L-shaped metal rod, with a fenestration through each end, one to secure the rod to the frame under a pulley and the other for the purpose of receiving a tube of any desired length, which is secured by means of a thumb screw.

#### SUMMARY AND CONCLUSION

1. Treatment of fractures at sea by traction and extension is seriously handicapped because of the pendulum motion of the extension weight caused by vibration, rolling, and pitching of a ship, which is very painful and annoying to patients.

2. The antipendulum or antijar swing extension apparatus and fracture frame has overcome these difficulties, and conservative methods of treating fractures of the humerus, femur, tibia, and fibula may be used to equal advantage afloat as ashore.

3. It not only prevents the pendulum motion caused by rolling and pitching but prevents careless attendants, visitors, and convalescing patients from striking the traction weights and setting them in motion.

4. The frame is compact, durable, simple in construction, inexpensive, and easily adjustable to meet any requirement. It is more slightly and less bulky than the Balkan frame, and therefore interferes less with the care and treatment of patients. It requires small space for storage when not in use, and in a few minutes it may be clamped to any bed or bunk. It is hoped that these features will render the frame as useful ashore as it has been at sea.

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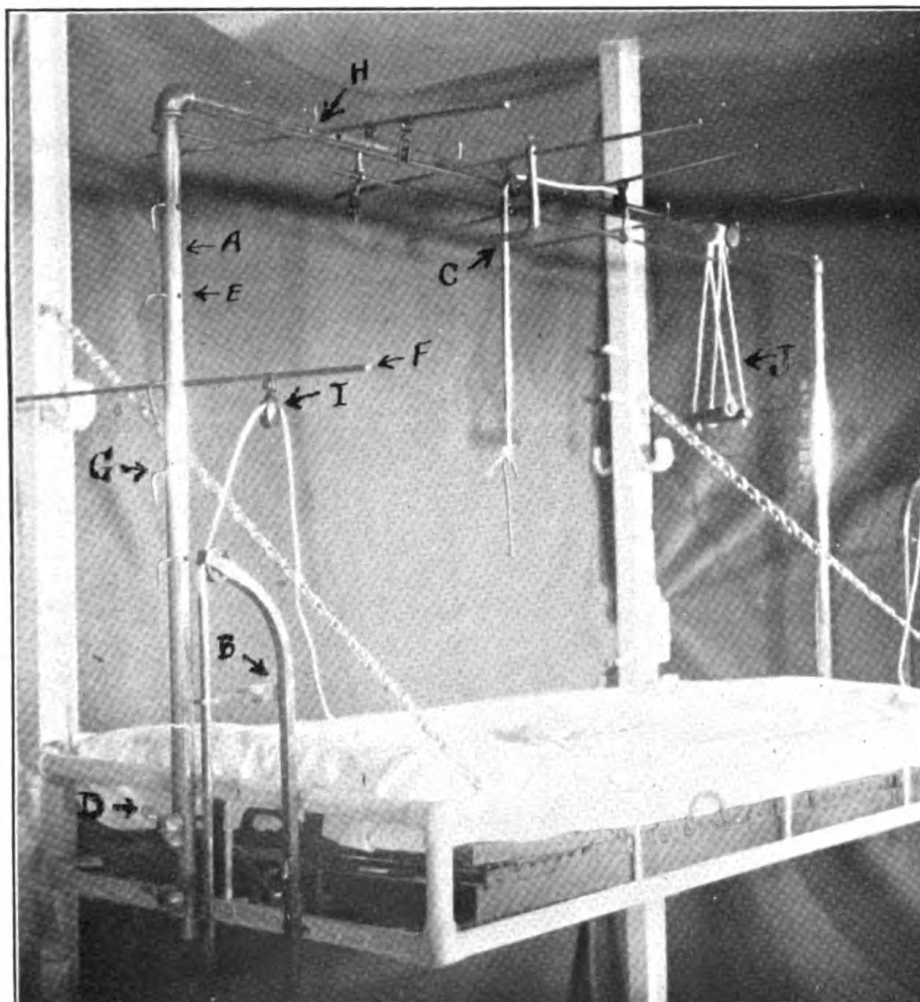


FIGURE 1.—PHOTOGRAPH SHOWING THE ANTIPENDULUM EXTENSION APPARATUS AND FRACTURE FRAME

A, Fracture frame; B, antipendulum apparatus for traction weights; C, antipendulum apparatus for weights suspended over the bed; D, clamp to secure frame to the bunk; E, fenestrations for steel rod; F, steel rod; G, thumb screw to secure the rod at any desired length; H, fenestrations are made in various directions so that any angle may be obtained; I, a pulley with a swivel is clamped to the rod; J, patient can lift his trunk by handgrips.



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### THE PHYSIOLOGICAL EFFECTS OF HIGH CONCENTRATIONS OF CARBON DIOXIDE<sup>1</sup>

By E. W. BROWN, Commander, Medical Corps, United States Navy

The object of this investigation was a study of the physiological effects of very high concentrations of carbon dioxide on men. By very high concentrations is meant toxic percentages ranging from 5.5 to 12.4 per cent with oxygen varying from 14.4 to 39.7 per cent. The reason for conducting these experiments was the need for more definite and extensive information as to the effects of dangerous concentrations of CO<sub>2</sub> on men in submarines under conditions of enforced submergence following a disaster. While considerable data have accumulated in the literature, the effects of the higher percentages of CO<sub>2</sub> have not been sufficiently determined.

The present study was carried out in conjunction with an investigation of the influence of relatively high oxygen on the noxious effects of high CO<sub>2</sub> in submarines, the results of which appeared in the July, 1930, number of the U. S. Naval Medical Bulletin (1). In those tests, however, very high percentages of CO<sub>2</sub> were not reached, the maximum being only 5.8 per cent.

#### THE EFFECTS OF HIGH CO<sub>2</sub> ON ANIMALS

It will be understood, unless otherwise stated, that sufficient oxygen was supplied in the various experiments to prevent any deficiency.

Bert (2), in his classic researches in 1878, found that death did not result with small animals in a closed space until CO<sub>2</sub> reached 30 per cent, the oxygen being kept at an ample concentration. Anesthesia was produced at high percentages, the blood pressure being raised and the pulse rate rapid. Life was not endangered by the anesthesia, if under 30 per cent, and recovery was prompt in fresh air.

Friedlander and Herter (3), in 1878-79, reported that rabbits could breath 20 per cent of CO<sub>2</sub> for approximately an hour without any apparent physiological effects except increased cardiac and respiratory activity. Marked depression resulted only after approximately a 24-hour exposure. With 30 per cent of CO<sub>2</sub> signs of toxicity developed rapidly, the animals becoming unconscious with

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<sup>1</sup> From the Medical Research Division, Edgewood Arsenal.

a gradual fall of body temperature and finally death. These authors exposed a rabbit to a mixture of 80 per cent  $\text{CO}_2$  with 20 per cent  $\text{O}_2$ , the animal becoming completely narcotized with a rapid drop of body temperature. It lived for one-quarter of an hour in this mixture, and recovered rapidly in pure air.

Benedicenti (4), in 1896, studied the action of high concentrations of  $\text{CO}_2$  on mammals, beginning with 10, 12, and 15 per cent. A purely narcotic effect was observed, the respirations being excited only for a short time. With 30 to 35 per cent there was no dyspnea, but narcosis developed in 30 to 45 minutes, with dilation of the pupils and nearly complete abolition of the corneal reflex. The animals survived for a considerable period.

Loewy and Zuntz (5), in 1899, found with animals that the greatest effect on increasing the ventilation of the lungs occurred at 15 per cent  $\text{CO}_2$ ; on exceeding this the breathing volume was reduced by the onset of narcosis. When below 15 per cent  $\text{CO}_2$  the breathing volume was increased and diminished in a definite ratio as the  $\text{CO}_2$  percentage was raised or lowered in the pulmonary alveoli.

On the other hand, Plavec (6), in 1900, reported that with animals an increasing breathing volume occurred up to 30 per cent of carbon dioxide but began to decrease with the onset of narcosis. With only 5 per cent of  $\text{CO}_2$ , dyspnea was distinct; with 10 per cent, a marked rise of blood pressure and slowing of the pulse resulted.

Nares (7) showed that rabbits had far greater resistance to  $\text{CO}_2$  than dogs, which may explain certain divergent results of earlier workers. He reported that rabbits could survive the inhalation of 80 per cent of  $\text{CO}_2$  with 20 per cent of  $\text{O}_2$  for a relatively long time, and recovered quickly in normal air. The respirations became greatly deepened in the course of the first minute with the expiratory phase lengthened so that the number of respirations were reduced to half in the first five minutes. An excess of  $\text{CO}_2$  induced a marked rise of blood pressure, but it finally dropped nearly to normal under exposure to a still heavier concentration.

Hill and Flack (8), in 1908, studied the circulatory effects of very high concentrations of  $\text{CO}_2$  on cats and dogs. The rise of blood pressure was most marked between 10 and 25 per cent. At first the hyperpnea increased with the rising concentration of  $\text{CO}_2$  until convulsive breathing resulted; especially marked in percentages from 15 to 30. Above 30 to 35 per cent the depressant and narcotic effects become more and more marked. With very high concentrations the excitatory effect was transitory, being rapidly followed by respiratory depression.

With moderate doses the blood pressure was raised and the vagus and vasomotor centers excited. With higher concentrations the

blood pressure fell owing to the depressant effect upon the heart muscle, the heart easily recovering from this effect by pure air and massage. They concluded that at 10 to 25 per cent of  $\text{CO}_2$  the vagus and vasomotor centers were stimulated; above 25 per cent the blood pressure falling and depressant effects ensuing, narcosis finally being established.

Sollman (9) concluded from a review of the literature that as high as 20 per cent of  $\text{CO}_2$  is not fatal in an hour to animals, and probably not to man. With 25 to 30 per cent the stimulant phenomena pass into depression with diminished respiration, fall of blood pressure, coma, anesthesia, and gradual death after several hours. There is a loss of reflexes but usually no convulsions.

#### THE EFFECTS OF HIGH $\text{CO}_2$ ON MEN

Here again it will be understood that the supply of oxygen was ample unless otherwise indicated.

Haldane and Smith (10), in 1892, found on breathing air containing 18.6 per cent  $\text{CO}_2$ , that profound dyspnea resulted in 1 to 2 minutes, attended by extreme discomfort, throbbing in the head, mental dullness, and cyanosis. When air was rebreathed from a large bag up to the limit of endurance, they had to stop at approximately 10 per cent of  $\text{CO}_2$ . The distress produced was virtually no different whether  $\text{O}_2$  was added or not. If more than 10 per cent was breathed, the effect of the mixture was to produce stupefaction. This effect on animals was already well known even at that time.

Haldane (11) has reported the effects of excess of  $\text{CO}_2$  in producing ataxia, stupefaction, and loss of consciousness in connection with the wearing of mine rescue and diving apparatus. The effects were readily produced in the presence of a large excess of  $\text{O}_2$ , and were therefore entirely independent of the effects of oxygen deficiency. He also stresses the narcotic effect of a large excess of  $\text{CO}_2$  in quieting down the respiration, which had led many previous observers to overlook almost entirely the effects of lower percentages in stimulating the breathing.

Hill and Flack (*ibid.*) reported that when excess of oxygen was rebreathed by a man from a closed space, the  $\text{CO}_2$  percentage rose to 10 per cent and slightly over before the breaking point occurred.

Speck (12), in 1892, reported that on inhaling 11.5 per cent  $\text{CO}_2$ , even the first breath was unpleasant. Disagreeable sensations immediately followed, with dimness of vision quickly developing. On increasing the  $\text{CO}_2$  in the inspired air from 0.95 to 11.5 per cent, a nearly fivefold increase in total lung ventilation resulted, the respiratory rate being trebled and the depth nearly doubled. At 7 per cent the  $\text{CO}_2$  of the inhaled air equaled that of the exhaled air.

Hill and Flack (8), in 1908, studied the effect of very high percentages of CO<sub>2</sub> on a man. He was entirely unable to even inhale a mixture of 38.2 per cent CO<sub>2</sub> and 9.1 per cent of O<sub>2</sub>. He could, however, inhale without spasm of the glottis 15.3 per cent of CO<sub>2</sub> with 14.5 per cent of O<sub>2</sub> for a few seconds, although extremely severe dyspnea resulted. Air containing 20 per cent of CO<sub>2</sub> brought about immediate partial closure of the glottis with a peculiar whooping sound on inspiration.

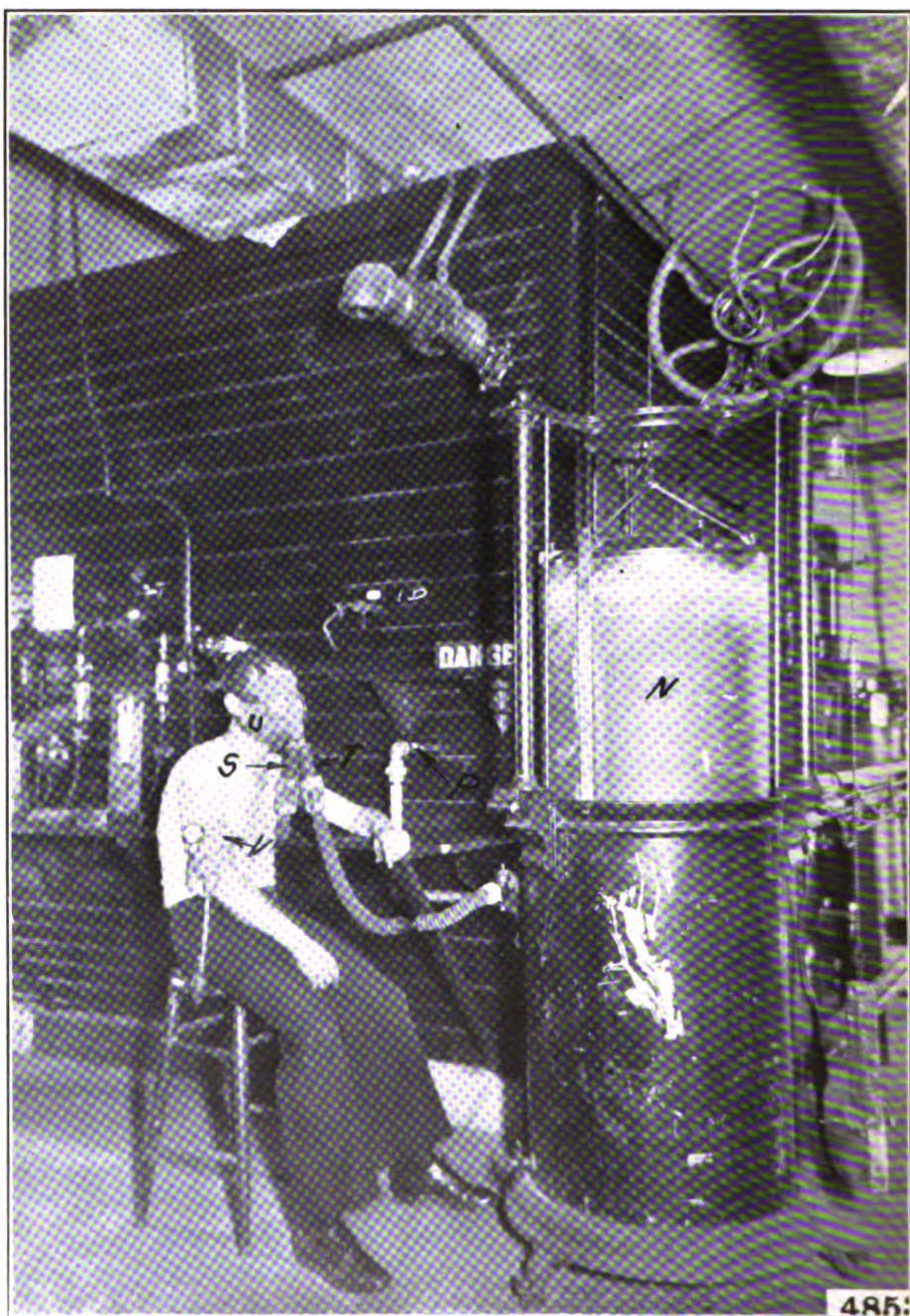
Haldane, Meakins, and Priestley (13), in 1919, stated that a moderate excess of CO<sub>2</sub>, which they regarded as 6 per cent, caused a considerable and persistent increase in the depth and a relatively slight rise in the frequency of respiration. The maximum increase in lung ventilation was produced when excess of CO<sub>2</sub> and deficiency of O<sub>2</sub> were both present.

Davies, Haldane, and Kennaway (14), in 1920, reported the effects of exposing a man in a respiration chamber to CO<sub>2</sub> at percentages of 5.2 to 6.4 per cent for periods of two hours. Immediately after entering the chamber the respirations gradually increased, in a few seconds reaching the maximum depth with a frequency between 22 and 30 and continued so throughout. No marked rise of pulse rate was observed. In one experiment a slight headache developed after eight minutes' exposure in the chamber, lasting throughout. In two other tests no headache occurred in the chamber, but headache of moderate severity with sudden onset and lasting several hours was observed immediately after emerging. There were no other notable after effects from these exposures to CO<sub>2</sub>.

Sollman (9), from a review of the literature, pointed out that high CO<sub>2</sub> first produces strong medullary stimulation and in very high concentrations, narcosis, 8½ per cent of CO<sub>2</sub> in man inducing almost immediate dyspnea, rise of blood pressure, and congestion, the situation becoming insupportable in 15 to 20 minutes, but clearing up promptly in fresh air. The medullary centers are first stimulated by excess of CO<sub>2</sub> in the order of respiratory, then vasomotor and then vagus centers to be followed by depression of these centers. An increase of CO<sub>2</sub> up to a certain point causes a marked rise in blood pressure, mainly by stimulation of the vagus center.

Schneider and Truesdell (15), in 1922, determined the normal curves of the circulatory and respiratory responses to a gradual increase of CO<sub>2</sub> in the inspired air. Two groups of experiments were carried out, in one the oxygen being maintained at 30 per cent and in the other the oxygen decreasing as the CO<sub>2</sub> accumulated in the inspired air. The average maximum of CO<sub>2</sub> reached was 7.3 per cent. The pulse rate was accelerated, the final averaging 11.6 and 15.5 in the two groups, respectively, with great variations between indi-





U—FACE PIECE OF GAS MASK.  
S—CONNECTION OF GAS MASK TO INTERIOR OF CHAMBER.  
T—CONNECTION OF GAS MASK TO SPIROMETER.  
N—SPIROMETER.  
V—BLOOD PRESSURE APPARATUS.

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vidual subjects, and usually first noted at 5 per cent  $\text{CO}_2$ . The systolic blood pressure began to rise in the majority of subjects at 2 to 4 per cent  $\text{CO}_2$ , the average final increase being approximately 14.7 millimeters in one group of the tests. The average final increase in diastolic pressure was 7.7 and 12.3 millimeters. The minute volume of breathing rose 31.6 per cent at 1 per cent, and up to 511.9 per cent at 7 per cent in one group of tests; in the other the corresponding figures were 23.9 and 516.9 per cent.

Goldstein and Du Bois (16), in 1927, reported a study of the effect of different concentrations of  $\text{CO}_2$  on the human circulation. One subject only was employed in their experiments. He rebreathed from a Douglas bag containing approximately 50 liters of the gas mixture. The maximum initial  $\text{CO}_2$  was 3 per cent and the maximum final 9.2 per cent; the observations being made at certain intermediate concentrations. It was found that the increase in systolic blood pressure, while progressive, actually occurred in three definite stages. The duration of each stage could be regulated by changes in the  $\text{CO}_2$  concentration of the rebreathed mixture. The systolic pressure, the diastolic pressure, and the heart rate showed a characteristic relationship to the changes in the pulmonary alveolar  $\text{CO}_2$  concentration.

## EXPERIMENTAL

### PROCEDURES

Seven male subjects were used, all of submarine personnel, the ages varying from 19 to 30.

The gas mixtures were set up in a respiration chamber which has been described in a previous article by the writer (1). The analyses for  $\text{CO}_2$  and  $\text{O}_2$  were made with the Henderson-Orsatt gas analysis apparatus. Carbon dioxide was supplied to the chamber from a cylinder, being passed successively through a wet meter and a flowmeter; oxygen by the same technique when relatively high concentrations were desired; nitrogen similarly as a diluent when low percentages of oxygen were desired in conjunction with high  $\text{CO}_2$ .

The subjects breathed the air mixtures by the method illustrated in the accompanying photograph.

A gas mask of the standard Navy type was adjusted to the subject. The mask was connected to rubber inspiratory and expiratory valves contained in glass bulbs with glass connecting pieces as shown in the photograph. The inspiratory valve was connected by corrugated hose to a steel tube piercing the wall of the respiration chamber; the expiratory valve to a balanced spirometer of 150 liters capacity. The subjects, therefore, inhaled from the chamber and exhaled into the spirometer. Peripheral resistance to breathing was virtually elimi-

nated as the connecting tubing of the assembly was approximately 1 inch in inside diameter.

The arterial blood pressures were read by the auscultatory method, using a Tycos aneroid instrument which had been checked against a mercury apparatus. The blood pressures were read twice at definite intervals during the period of exposure varying from one-half to five minutes depending on the length of the experiment. The maximum reading only is recorded in the tables. The blood pressure was also read five minutes after the end of the test.

The pulse rate was counted at the radial artery and the respiratory rate by observation of the average number of oscillations of the spirometer per minute during the reading of the minute-volume of expiration.

The minute-volume of expiration was determined from the final reading of the spirometer, the subject exhaling into the instrument during the entire experimental period except for the intervals required to empty it in order to start a second reading. The total minute-expiration volume was then computed by dividing the total volume by the number of minutes as recorded by the stop watch.

Normals for pulse rate and blood pressure were read in each test immediately prior to the experiment. The normal minute-expiration volume was not determined at the time for the reason that adequate normal data had already been collected in connection with previous tests (1), being based on the averages of three to five tests: each being taken at intervals of not less than 24 hours.

#### DISCUSSION OF THE DATA

The concentrations of  $\text{CO}_2$  were so excessive as to be intolerable within a comparatively short time. It will be noted, however, that the periods of exposure to the same concentration showed considerable variation. This was largely due to individual differences in tolerance toward the mixtures of gas breathed. The periods of exposure recorded do not represent the maximum record of endurance under the conditions but they do indicate the time interval beyond which serious symptoms were threatened.

It will be noted that there are seven groups of tests presented in Table I arranged in the order of ascending percentages of  $\text{CO}_2$ , i. e., from 5.5 to 12.4 per cent, inclusive. The test at 5.5 per cent  $\text{CO}_2$  was carried out for purposes of comparison, this percentage not being considered as in the high category.

Certain of the table headings require brief comment. The "Minute-Expiration Volume Rise per cent" indicates the percentage increase in liters per minute as compared with the average reading when breathing atmospheric air. Under "Pulse Rate" the reading taken just prior to the test is recorded under "B"; that taken at

approximately the midpoint of the test under "D." Under "Blood Pressure," "B" indicates the reading just before, "D" the maximum systolic during, and "A" that taken five minutes subsequent to the test. The "Systolic Rise per cent" and "Diastolic Rise per cent" record the percentage increase over the normals taken just prior to the experiments.

A summary of the physiological data is assembled in Table II. It will be noted that the maximum and minimum data with the average for all subjects are recorded under the respective table headings.

TABLE I

CO<sub>2</sub>: 5.5 per cent; O<sub>2</sub>: 14.5 per cent

Subject	Duration, minutes	Respiratory rate	Pulse rate		Minute expiration volume liters per minute	Minute expiration volume rise, per cent	Blood pressure			Systolic rise, per cent	Diastolic rise, per cent
			B	D			B	D	A		
B.....	5	16	100	103	30	173					
H.....	5	12	80	90	23	109					
K.....	5	27	74	86	43	291					

CO<sub>2</sub>: 5.9 per cent; O<sub>2</sub>: 40.6 per cent

B.....	5	16			26	136					
H.....	5	16			32	200					
I.....	5	27			27	125					
J.....	5	14			37	185					
K.....	5	19			33	200					
L.....	5	27			46	320					
S.....	5	29			29	123					

CO<sub>2</sub>: 6.0 per cent; O<sub>2</sub>: 21.1 per cent

B.....	20½	18	77	82	29	164	108	118	108	9	0
H.....	22	13	77	84	26	136	82	82	78	3	11
K.....	21	28	85	96	45	309	70	78	70	15	12
							122	140	118		
							82	92	84		

CO<sub>2</sub>: 7.5 per cent; O<sub>2</sub>: 16.0 per cent

B.....	5	21	90	102	43	291	102	132		29	14
H.....	6	16	77	86	28	154	72	82		31	34
I.....	3½	25	70	80	36	200	108	142	106	18	24
J.....	3¼	18	70	80	54	315	64	86	66	29	15
K.....	4½	22	80	96	39	254	108	128	103	19	17
S.....	5	30	73	76	32	137	66	82	63	17	19
							110	142	112		
							80	92	72		
							119	142			
							72	84			
							113	132	108		
							67	80	72		

TABLE I—Continued

CO<sub>2</sub>: 8.8 per cent; O<sub>2</sub>: 38.7 per cent

Subject	Duration, minutes	Respiratory rate	Pulse rate		Minute expiration volume liters per minute	Minute expiration volume rise, per cent	Blood pressure			Systolic rise, per cent	Diastolic rise, per cent
			B	D			B	D	A		
H.....	10	17	71	78	33	200	110	144	98	31	11
I.....	8	27	76	102	34	183	74	84	63	14	8
							112	128	103		
J.....	7	18	70	85	42	223	74	80	66	23	12
							115	142	115		
K.....	7	24	85	94	44	300	82	98	82	23	12
							104	128	98		
L.....	9	24	72	81	37	236	68	76	76	19	20
							102	122	106		
							68	82	72		

CO<sub>2</sub>: 10.4 per cent; O<sub>2</sub>: 14.4 per cent

B.....	½	22	78	102	39	254	108	142	108	31	30
H.....	2¼	19	75	87	36	227	72	94	68	34	41
							112	160	110		
I.....	2	35	74	95	51	300	60	104	67	26	37
							114	144	122		
J.....	1½	20	77	90	66	407	54	74	60	43	35
							120	172	120		
K.....	1	19	74	119	39	254	78	105	82	38	36
							122	168	118		
L.....	1½	20	76	83	35	218	72	98	74	28	44
							108	138	110		
S.....	2	33	72	81	53	293	66	95	72	32	45
							118	156	120		
							66	96	68		

CO<sub>2</sub>: 12.4 per cent; O<sub>2</sub>: 39.7 per cent

B.....	1	18	70	92	30	172	112	200	-----	78	30
H.....	2	18	79	103	23	109	72	94	-----	21	12
							113	137	-----		
I.....	1	19	74	84	19	58	69	77	-----	23	57
							109	134	-----		
J.....	¾	17	83	94	35	170	51	80	-----	75	29
							116	203	-----		
K.....	1	21	92	98	32	190	76	98	-----	97	18
							100	197	-----		
L.....	1	22	74	81	38	245	67	79	-----	54	24
							112	173	-----		
S.....	1	27	76	88	31	129	70	87	-----	36	21
							109	148	-----		
							70	85	-----		

TABLE II.—Summary of physiological data

Number subjects	CO <sub>2</sub> per cent	O <sub>2</sub> per cent	Respiratory rate rise		Pulse rate rise		Minute expiration volume rise, per cent		Systolic rise, per cent	Diastolic rise, per cent
			<i>Average</i>		<i>Average</i>		<i>Average</i>		<i>Average</i>	<i>Average</i>
3.....	5.5	14.5	(1)		3-12	8	109-291	191	-----	-----
7.....	5.9	40.6	(1)		-----	-----	123-320	184	-----	-----
3.....	6.0	21.1	0-12	4	5-11	7	136-309	203	3-15	9
6.....	7.5	16.0	0-14	6	3-16	10	137-315	225	17-31	24
5.....	8.8	38.7	1-11	4	7-26	13	183-300	228	14-31	22
7.....	10.4	14.4	3-19	8	7-45	19	218-407	279	26-43	33
7.....	12.4	39.7	1-11	4	7-24	13	53-245	153	21-97	55
									8-20	13
									30-45	38
									12-57	27

<sup>1</sup> Variable.

## OBJECTIVE SYMPTOMS

(a) *Respiratory rate.*—The normal respiratory rates were not actually determined, but an average figure of 16 per minute for comparison was assumed.

With CO<sub>2</sub> at 5.5, 5.9, and 6 per cent, with corresponding oxygen at 14.5, 40.6, and 21.1 per cent, there was a tendency to a slight rise in the majority of the subjects, although an apparent actual slowing occurred in certain instances. With CO<sub>2</sub> at 7.5 per cent the effect varied from 0 to plus 14 with an average rise of 6. At the still higher figure of 8.8 per cent of CO<sub>2</sub>, the increase varied from 1 to 11, averaging at 4; while at 10.4 per cent the average was 8. At 12.4 per cent of CO<sub>2</sub> the rate appeared to be somewhat slower, the rise ranging from 1 to 11 with an average of 4. The conclusion is drawn that at concentrations of CO<sub>2</sub> varying from 5.5 to 12.4 per cent there is a tendency to an increase in the respiratory rate, but it is comparatively slight.

(b) *Pulse rate.*—At 5.5 per cent of CO<sub>2</sub> there was a rise of pulse rate from 3 to 12 with an average of 8. The average increases at 6, 7.5, 8.8, and 10.4 per cent were 7, 10, 13, and 19, respectively. In general, the rise in pulse rate, while variable, was moderate with a tendency to increasing acceleration up to and including 10.4 per cent of CO<sub>2</sub>. The pulse rate increase at 12.4 per cent CO<sub>2</sub> varied from 7 to 24 with an average of 13, there being no tendency to a rise above the trend of the data at 10.4 per cent CO<sub>2</sub>. Individual differences in the rise for all groups were marked.

(c) *Minute-expiration volume.*—The average increases at 5.5, 5.9, and 6 per cent CO<sub>2</sub> were 191, 184, and 203 per cent, respectively, the expiration volume being practically doubled at 6 per cent CO<sub>2</sub>. There were wide individual variations, i. e., 136 to 309 per cent at 6 per cent, 109 to 291 per cent at 5.5 per cent, and 123 to 320 per cent at 5.9 per cent.

The average respective increases at 7.5, 8.8, and 10.4 per cent CO<sub>2</sub> were 225, 228, and 279 per cent. The corresponding data at 5.5, 5.9, and 6 per cent were 191, 184, and 203 per cent. The trend was for this value to rise with an increasing CO<sub>2</sub>, but even from 6 to 10.4 per cent the actual average increase was only 37.4 per cent. The difference between 8.8 and 10.4 per cent CO<sub>2</sub> was negligible, i. e., less than 10 per cent. Apparently the lung ventilation was not materially increased above 7.5 per cent. The average was practically tripled at 6 per cent and only raised 24 per cent above that figure at 10.4 per cent CO<sub>2</sub>.

At 12.4 per cent CO<sub>2</sub> there was a definite fall in the expiration value; the percentage increase above normal varying from 58 to 235

per cent with an average of only 153 per cent. It will be noted that the data are even distinctly lower than at 5.5 per cent. In other words, the actual ventilation of the lungs decreased strikingly when CO<sub>2</sub> rose above 10.4 per cent. This was in all probability a direct toxic effect of the high CO<sub>2</sub> concentration.

(d) *Blood pressure: Systolic.*—The blood pressure was not taken in the tests at 5.5 and 5.9 per cent CO<sub>2</sub>. At 6 per cent the percentage rise varied from 3 to 15 per cent, with an average of 9 per cent. At 7.5, 8.8, and 10.4 per cent the respective average increases were 24, 22, and 33 per cent. The range of individual variations was considerable—i. e., from 17 to 31 at 7.5 per cent, 14 to 31 at 8.8 per cent, but at 12.4 per cent there resulted a very marked rise, ranging from 21 to 97 per cent and averaging at 55 per cent.

The maximum systolic readings at 12.4 per cent were 203, 200, 197, and 173 for four subjects. On the other hand, the respective maximum readings for the three remaining subjects were only 148, 134, and 137. These contrasting data bring out the wide range of response in blood pressure obtaining between different subjects. Marked individual fluctuations were also observed at lower concentrations of CO<sub>2</sub>.

(e) *Blood pressure: Diastolic.*—There was a rise of diastolic blood pressure in all groups of tests in which this response was observed. At 6 per cent CO<sub>2</sub> the increase varied from 0 to 12 per cent and averaged 7 per cent. The rise was much greater at 7.5 per cent CO<sub>2</sub>, varying from 14 to 34 per cent and averaging 20 per cent. The increase was somewhat less at 8.8 per cent CO<sub>2</sub>, averaging only 13 per cent, but showed a marked rise of 38 per cent at 10.4 per cent CO<sub>2</sub>. Up to this point the diastolic tended roughly to increase with the systolic blood pressure. At 12.4 per cent CO<sub>2</sub>, however, the average diastolic rise was lowered to 27 per cent, as against a decided average increase of the systolic pressure of 55 per cent.

The maximum reading of the diastolic pressure for all tests was 105 at 10.4 per cent CO<sub>2</sub> and the minimum in that group was 74. The maximum figure at 12.4 per cent CO<sub>2</sub> was 98, the minimum 77. The corresponding results at 8.8 per cent CO<sub>2</sub> were 98 and 76. Individual variations therefore were conspicuous.

The data for both systolic and diastolic blood pressure had fallen to practically normal at all concentrations of CO<sub>2</sub> when taken five minutes after the end of the period of exposure.

#### SUBJECTIVE SYMPTOMS

*Periods of exposure.*—The period at 6 per cent CO<sub>2</sub> varied from 20½ to 22 minutes, which could have been extended. Although considerable discomfort resulted toward the end, the situation was not intolerable. At 7.5 per cent CO<sub>2</sub> the period ranged from 31½ to 6

minutes. The symptoms were more urgent, but here again the limit of endurance was not reached. For this reason the periods of exposure at 8.8 per cent  $\text{CO}_2$  were lengthened to a point much nearer the intolerable limit. Naturally with human subjects it was essential to be on guard against dangerous symptoms. At 10.4 per cent  $\text{CO}_2$  the maximum period was  $2\frac{1}{4}$  and at 12.4 per cent  $\text{CO}_2$ , 2 minutes. It was not considered advisable to exceed these limits with such very high concentrations, in view of the effect on the morale of the subjects.

The subjective symptoms observed during exposure were as follows: Panting and dyspnea almost immediate, the respiratory efforts resembling the effect of tremendous physical exertion with the sensation that inspiration was beginning before expiration was completed; dizziness, feeling of fullness in the head, sensation of flushing and actual sweating of the face; drowsiness tending to actual stupor, sense of impending collapse, irritation of the throat, and a slight choking sensation.

On removing the mask, the face was distinctly cyanosed in certain cases and the expression dazed. The condition tended to be semi-stuporous for a fraction of a minute afterwards. Two of the subjects who were Hospital Corps men described the stuporous sensation during the test as similar to the incipient effect of a general anesthetic. They felt that they would have lost consciousness within a few minutes if the time of the tests with the two highest concentrations of  $\text{CO}_2$  had been extended. Subject J actually collapsed at 12.4 per cent of  $\text{CO}_2$ , but regained complete consciousness in approximately one-half minute after removing the mask, with no subsequent symptoms except a slight headache. It was not considered advisable to continue the tests at 10.4 and 12.4 per cent beyond a minute or two on account of the danger of collapse. None of the subjects experienced nausea or throbbing of the temples at any time. It is not believed that any of the subjects could have withstood 10 per cent of  $\text{CO}_2$  for longer than 10 minutes without complete stupefaction.

The subsequent symptoms were comparatively mild. Headache, although not present in all, was the most pronounced, but not beyond 30 minutes. Drowsiness, or a dazed condition, continued for a few minutes in certain subjects, but general weakness was not complained of.

There were marked individual variations in the number and severity of the subjective symptoms between different subjects under similar conditions. Thus headache resulted in some, but not in other subjects; dyspnea varied in severity; depression and drowsiness were more marked with certain individuals; the degree of dizziness varied. One subject would report that the limit of endurance had been nearly

reached; another that he could have held on under the conditions for several minutes longer. Subject H was remarkably resistant in contrast to the other subjects and was outstanding in this respect in all tests. The degree of dyspnea and depression, particularly, were strikingly less.

*The influence of oxygen.*—The concentration of oxygen was varied considerably in certain of the tests. The question arises whether this factor had any definitive influence in ameliorating the objective or subjective symptoms induced by the large excess of CO<sub>2</sub>. It will be noted in Table II that two tests were carried out at practically 6 per cent CO<sub>2</sub> with the oxygen 21.1 per cent in one and 40.6 per cent in the other. The minute-expiration volume and the subjective symptoms showed no marked differences in the two tests.

Another comparison was afforded between CO<sub>2</sub> at 7.5 per cent with 16 per cent O<sub>2</sub> and at 8.8 per cent with 38.7 per cent O<sub>2</sub>. The objective signs were distinctly greater at 8.8 per cent CO<sub>2</sub> and the subjective symptoms more intense, despite the association with high oxygen. Still another comparison was brought out between CO<sub>2</sub> at 10.4 per cent with 14.4 per cent O<sub>2</sub> and at 12.4 per cent with 39.7 O<sub>2</sub>. There was a large increase in the subjective effects and in the systolic blood pressure at 12.4 per cent CO<sub>2</sub>, although associated with high oxygen. The trend of these data indicated that high oxygen as compared with normal or moderate low oxygen did not minimize the physiological effects of excessive concentrations of CO<sub>2</sub>.

#### SUMMARY

1. The subjective and objective effects of toxic concentrations of CO<sub>2</sub> on men were studied; the percentages varying from 5.5 to 12.4 per cent with oxygen ranging from 14.4 to 39.7 per cent.
2. The concentrations of CO<sub>2</sub> were so excessive as to be tolerated for only a comparatively short time. The periods of exposure did not represent the extreme limit of endurance but a stage was reached beyond which serious symptoms were impending. The maximum period of exposure was 22 minutes at 6 per cent and the minimum one-half minute at 10.4 per cent CO<sub>2</sub>.
3. The respiratory rate per minute showed a tendency to a slight increase above normal, the average rise being only 8 at 10.4 per cent CO<sub>2</sub>. The average increase at 12.4 per cent CO<sub>2</sub> was negligible, reaching only 4.
4. The pulse rate per minute was accelerated in moderate degree, the average rise varying from 7 at 6 per cent CO<sub>2</sub> to 19 at 10.4 per cent. It was 13 at 12.4 per cent.
5. The systolic blood pressure always increased and rose with ascending CO<sub>2</sub> concentration. The maximum increase at 6 per cent



CO<sub>2</sub> was 18 millimeters, the minimum 4 millimeters; the corresponding data at 10.4 per cent were 52 and 30 millimeters; at 12.4 per cent, 97 and 24 millimeters. The average percentage rise was 55 per cent at 12.4 per cent CO<sub>2</sub>, 33 per cent at 10.4 per cent, and 24 per cent at 7.5 per cent CO<sub>2</sub>.

6. The diastolic blood pressure showed in general a trend similar to that of the systolic pressure. The maximum increase at 6 per cent CO<sub>2</sub> was 10 millimeters, the minimum 0 per cent; the corresponding data at 10.4 per cent were 34 and 20 millimeters; at 12.4 per cent, 29 and 8 millimeters, being less than at 10.4 per cent. The average percentage rise was 27 at 12.4 per cent CO<sub>2</sub>, 38 at 10.4 per cent, and 20 at 7.5 per cent.

7. The average minute-expiration volume per minute increased as follows: 203 per cent at 6 per cent CO<sub>2</sub>, 225 per cent at 7.5 per cent, 228 per cent at 8.8 per cent, 279 per cent at 10.4 per cent, and only 153 per cent at 12.4 per cent CO<sub>2</sub>. The last-named result is of particular interest as it indicates a fall in the lung ventilation at this concentration of CO<sub>2</sub> whereas there was a rising increase up to and including 10.4 per cent CO<sub>2</sub>. There were wide individual differences between subjects as was observed in the other physiological responses.

8. The subjective symptoms were as follows: Marked dyspnea resembling the effect of extreme physical exertion; dizziness; flushing and sweating of the face; feeling of stupefaction and an apprehension of impending collapse. The after effects were practically limited to moderately severe headache but not persisting beyond 30 minutes. There was marked individual variation in the severity of the symptoms, certain subjects showing much less intolerance to high concentrations of CO<sub>2</sub> than others. It is not believed that any of the subjects could have withstood 10 per cent CO<sub>2</sub> for longer than 10 minutes without losing consciousness.

9. There was no evidence that high oxygen alleviated the toxic effects of the excessively high concentrations of CO<sub>2</sub> employed in these experiments.

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### SOME THOUGHTS FOR THE FUTURE<sup>1</sup>

By K. C. MELHORN, Captain, Medical Corps, United States Navy

MR. PRESIDENT, FELLOW MEMBERS OF THE SOCIETY, AND THEIR GUESTS:

In this, the last time that I shall have the privilege of appearing on the program of the society, I will ask your indulgence for a few moments in talking frankly regarding the future of your public-health service as I see it. If I say some things that are unpleasant or perhaps disagreeable, they are mentioned only because they should be and because we are not a group of "yes men" always saying nice things to please. God help you all if this society ever permits its meetings to degenerate into such a state of affairs that members hesitate to frankly and fully voice their opinions.

How true the saying: "Where there is no vision the people perish." If there ever was a time when broad vision is required in Haiti's public health service it is now—daily and hourly—in every unit where the comfort and good will of people are properly considered. Executives and their staffs who lack imagination can not appreciate mental attitudes. In no phase of public-health work can we afford to be complacent. The policy of a powerful organization is definitely concerned with the winning and holding of the confidence of the people and, before that can be done, it must sell itself to the public. People must be made to feel that on coming into our hospitals and meeting members of the staff that they are coming into the professional homes of our doctors and nurses.

As stated in a recent publication: "Hospitality in a hospital should begin at the front door. The courtesy and the cordiality one receives with his first greetings after admission, and during his stay in the hospital are the things that sell the hospital to him and through him to the community. A hospital in bad repute that has a reputation for being cold, unsympathetic, rude, soon loses the confidence of its patients and this will contribute in no small degree to their discomfort as well as retard their recovery. A disgruntled physician or nurse will react adversely on a patient and can easily influence his prejudice against the hospital. These matters are not in any wise inconsistent with good organization, good order, or discipline. As a

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<sup>1</sup> Delivered at the fourth annual congress of the Haitian Medical Society, Port au Prince, Haiti, June 5, 1930.

matter of fact, satisfied patients make for good order and progress, because their praise invariably increases the morale of the hospital personnel and good morale is one of the most vital reasons for the success of any business."

All health matters must depend in their final disposition on the will of the people, and this in turn must be the result of a developed intelligence which will sweep aside ignorance and selfishness. Health is purchasable, as so often stated, but not so much in terms of dollars and cents as in the contributions of individual loyalty to the standards proclaimed by our authorities.

You are seeking permanent, not temporary, foundations for the health of Haiti and must seek them candidly and fearlessly. As always, the right will prove to be expedient.

What shall you do, then, to push this great campaign for health to its righteous conclusion? You must clear away with a thorough hand all impediments to success and you must make every adjustment of law that will facilitate the full and free use of your whole capacity and force as a fighting unit.

Two tremendous obstacles stand in your way. They are the weak support of your courts and your lack of social-service work. Regarding the first, we have discussed it on several occasions and shall not renew it here. With respect to the second, how many have ever stopped to think how little has been attempted in Haiti in the field of social service? How feeble has been the response to the call, "Who is my neighbor?" Do you know that in this city of 80,000 people there are but four ladies who, without financial return of any kind, are engaged in real social-service activities, who are doing a magnificent work in a quiet way, who are finding out what are the handicaps to health in their city, where the disease-ridden sections are, and what the practical solution is? When Haiti can enlist 1,000 more such women in the cause of public health you need have no fear for the future. When the group consciousness that has manifested itself so strikingly in Haiti during the past year will direct its attentions to the needs of the public-health service and will actually participate by organized effort in practical welfare work the result of your battle for health will no longer be in doubt.

To succeed, organized effort in the future must be directed not only to the continued support of hospitals, clinics, and sanitation units but the program of medical examination of school children, oral hygiene, and public-health nursing must be firmly established as the supporting framework of the whole structure. If traveling clinics, health centers, and public-health education measures are not developed as strong reserves for your front-line units of hospitals, dispensaries, and rural clinics, you will not succeed. In other words, without these

things the present position of your public-health service can not be maintained; it will not endure.

In conclusion, I wish to tell you what every Haitian should be keenly interested in—that our program for 1930 to 1933 calls for the complete withdrawal of United States naval personnel from the districts of Jacmel, Cayes, and Hinche; and from Cap-Haitien, Gonaives, and Port au Prince in the years 1933 to 1936. In this, as you also know, there is nothing new. The plan is not the result of the exciting times through which we all have passed in the last year. It is the same program that has been in effect since June 15, 1927—a program that in three years has effected the complete Haitianization of 4 of the 10 districts.

Finally, may we never forget that “Until public health becomes a private responsibility it will not become a public achievement.”

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#### GUNFIRE DEAFNESS IN THE NAVY

By G. B. RIDOUT, Lieutenant (Junior Grade), Medical Corps, United States Navy

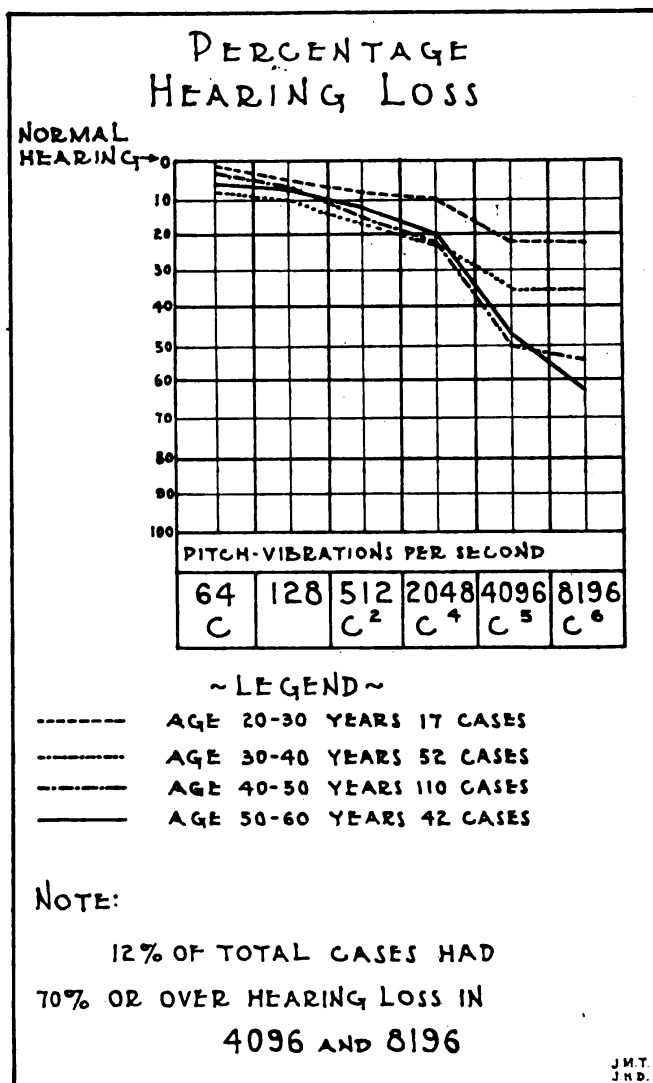
In the course of treatment of ear conditions at the naval dispensary in Washington it was observed that an unusually large number of officers on active duty had hearing defects in the higher tones, and that no special attention had been given to these defects in previous examinations; or, at least, notations had not been made of the existing condition. In order that a more detailed observation of such cases might be made, a special study of hearing acuity was made during the examination of 550 officers during the last annual physical examination.

In addition to obtaining accurate data upon the amount of hearing loss, it was also possible to make a rather sharp differentiation between (*a*) conductive deafness, usually resulting from inflammatory changes either in the middle ear or eustachean tube, and (*b*) nerve deafness, partial or complete, caused by pathological changes in the labyrinth or tracts of the auditory nerve. It was found that a large majority of cases in the series were of the latter type.

Undoubtedly many medical officers have made similar observations, but since no complete report of a series of such cases has been made, it was thought worth while to present the data obtained.

In addition to the usual watch, whispered voice, and coin tests, 225 officers were tested with the audiometer. The instrument used was the standard Western Electric 2-A audiometer, found in several of the naval hospitals. This apparatus produces tones of eight different pitches, ranging in regular intervals from 64 to 8,200 vibrations per second. Through a rheostat control, it is possible to vary the

intensity at each pitch. Estimation of hearing loss is expressed in terms of percentage, assuming total loss of useful hearing to be 100 per cent. In addition to its usefulness in giving a definite mathematical value in expressing diminution of hearing, the instrument serves as an important diagnostic agency, as it is a convenient source of the low and high tones which distinguish between the conductive



and nerve types of deafness, and can also be used to make the bone conduction tests.

In the cases under discussion the line of demarcation between the conductive and nerve types of deafness was usually a sharp one and allows a rather definite diagnostic conclusion. In the large majority of those in whom impairment was found the higher tones only were

affected, and frequently it was noted that the hearing for the lower tones was entirely normal and, occasionally, above normal. In a few cases, however, it was observed that all tones were affected and that the existing deafness undoubtedly was of a mixed type. Where the higher tones alone were affected the bone conduction usually was found to be somewhat diminished, and no gross lesion of the external canal nor of the drum membrane was evident, except for an occasional retraction of the drum.

The officers examined have been grouped into 10-year periods. (See chart.) It will be seen that the largest age group was from 40 to 50 years, at which time there normally is no appreciable physiological diminution due to advancing years. Kerrison (1) states that "any appreciable diminution of hearing for the upper musical tones in a person not over 50 years of age points either to a labyrinthine or nerve lesion." In point of service nearly all were officers of the line and had quite similar duty and exposure to gunfire throughout their naval careers. In several instances the officers were able to date their hearing impairment from some particular exposure to gunfire during target practice.

There is considerable clinical and experimental evidence to support the conclusion that the etiological factor in production of this nerve deafness is the concussion of gunfire upon inadequately protected ears. It was observed many years ago that men in the boiler-making trade suffer from a similar loss of hearing in the higher tones, and the term "boiler makers' disease" was given to this condition. Upon autopsy of several such cases it was found that the short fibers of the basilar membrane of the cochlea, which receive and resonate the higher vibrations, had undergone degeneration and atrophy (2). Surg. Capt. K. Ishihara (3) reports the results obtained on experimental animals placed on board the Japanese battleship *Tosa* during target practice. He was able to demonstrate pathological changes after exposure, both in the organ of Corti and in the spiral ganglia cells.

In the majority of cases, diagnosis can only be made through the use of forks of more than 1,000 vibrations per second, the Galton whistle, or as was done in the present series, by the audiometer. It was found that only when the upper tone loss was nearly absolute, and merged into the lower tones, that detection was possible by the coin click and whispered voice tests. Then, too, the last-mentioned tests are subject to such wide variations in application, that what may be a loud whisper or coin click to one examiner, may be quite faint to another. In most of the cases, however, there was a diminution of the distance at which a watch could be heard.

Since the highest number of vibrations used in music is but 4,000 per second, and since ordinary conversational tones are very much

lower in pitch, it is an interesting fact that most of the officers were aware of their impairment of tone perception, even though it was not evident until over 2,000 vibrations had been reached. Many officers stated that they had been aware of this impairment for a period of years. The usual history was that the officer could not hear a telephone ring at a distance, or that he had difficulty in hearing over a telephone or radiophone. Another common symptom was that in a rather crowded, noisy room, it was difficult to hear conversation quite near by.

The treatment for nerve deafness is entirely one of prevention. There is obviously no treatment which will avail when once the degeneration and atrophy of the basilar membrane and spiral ganglia cells have been established. Massage of the tympanic membrane, inflation of the eustacheon tube, and similar manipulations, however useful such may be in catarrhal deafness, have no place in the treatment of the nerve type. Where a combined type of deafness exists, however, some improvement in lower tone reception may follow employment of such measures.

The problem of ear protection is one which has been extensively studied, and the work of Tribble and Watkins (4) at Indianhead in 1918 serves as a valuable guide in the selection of a proper means of protection. After a series of experiments, in which both the patented appliances, and also the usual cotton protection were tested, it was found that most of the patented devices were nearly useless, that dry cotton gave but little protection, and that the best prophylactic measure was the insertion of vaseline-saturated cotton into the external meatus. This is a very simple method, and one which is always available.

#### SUMMARY

Naval personnel, because of the peculiar exposure to great vibratory disturbances, suffers from an occupational deafness far more generally than has been suspected. The deafness is usually of the nerve type, and often of sufficient degree to cause definite symptoms in those affected. It is believed that a more thorough examination of hearing should be made on annual examination, and that record of any existing deafness be entered in the health record. Valuable prophylactic measures would include issuance of vaseline-saturated cotton to personnel prior to target practice, along with definite instruction and demonstration as to its proper use.

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**DESIGNATIONS USED IN RECORDING ADMISSIONS TO THE SICK LIST**

By LENA WILLIGE, Section of Vital Statistics, Bureau of Medicine and Surgery, Navy Department

Beginning with the calendar year 1925, the designations "existed prior to entry into the service" and "admitted contributory disabilities" were included in the list of titles under which patients may be admitted to the sick list. Thus the "detailed statement of diseases and injuries" in the annual report of the Surgeon General (p. 220 in 1929 report) now includes in addition to the original admission, "A" column, two qualified admission columns, one "existed prior to entry into the service" ("EPTE"), and one for "admitted contributory disabilities" ("ACD"). The original admission, "A" column, includes all disabilities which have developed since entry into the service and which bear no relation to any previous entries to the sick list. The "EPTE" column includes only first entries for diagnosis reported under the prior disabilities, all subsequent reporting under the same diagnostic titles being recorded in the readmission ("RA") column. The "ACD" column includes first entries for diagnosis reported under disabilities which bear a relation to previous entries to the sick list, as complication, sequel, disabilities resulting from treatment of and disabilities incident to a primary disability. By this method the original admissions for disabilities which are chargeable to the service are obtained, and at the same time the number of cases under any particular diagnosis may be ascertained by adding the figures in these three columns.

All of the rates of admission to the sick list for the entire service are based upon original admissions ("A"). Therefore in collecting the vital statistics it is most important that patients be taken up properly on the sick list.

With the admission of each patient the previous medical history sheets and the medical abstract contained in his health record must be referred to before determining the manner of taking him up on the sick list. The same study must be given to each disability when a change of diagnosis is made while the patient is on the sick list.

There being no previous entry of admission to the sick list, the only decision in regard to the present disability is whether or not it existed prior to entry into the service. Frequently patients are taken up under diagnoses which in themselves suggest that the disabilities have been of some standing, such as dementia præcox, enuresis, epilepsy, flat foot, hookworm disease, redundant prepuce, teratoma, varicocele, varicose veins; but medical officers often use designations indicating that these disabilities did not exist prior to entry into the service. Possibly these cases are reported as original admissions because no notations were made of the disabilities at the



time the patient entered the service. Even though there are no such notations, disabilities which existed prior to entry into the service must be so reported for statistical purposes. If it is decided that the present disability existed prior to entry into the service it will be taken up as a readmission, "RA," otherwise as an original admission, "A."

Should there be an entry under the same diagnostic title previously used for the same patient, then the question arises, Is the present disability a recurrence or continuation of the condition previously entered, or a new and independent development? For example, if the present disability is diagnosed bronchitis, chronic, and there is a previous entry under that title, the case will be taken up as a readmission, "RA," there being no doubt as to the bronchitis, chronic, being a recurrent attack; but if the present disability is diagnosed bronchitis, acute, and some time has elapsed since the previous attack, the case should be entered as a new admission, "A." If a very short time has elapsed it is possible that the first attack had not really cleared up, so that the present attack is a continuation, and the entry would be "RA."

If there is a previous admission to the sick list under another diagnostic title the present disability will be taken up as "ACD" if it bears any relation to the condition previously entered. For example, in pneumonia, lobar, following influenza, pneumonia, lobar, is an "ACD" of influenza; in adhesions, peritoneum following appendicitis, chronic, adhesions, peritoneum is an "ACD" of appendicitis, chronic; in a reaction from neoarsphenamine administered for syphilis, poisoning, acute, neoarsphenamine is an "ACD" of syphilis; in dislocation, shoulder, sustained during an epileptic seizure, dislocation, shoulder is an "ACD" of epilepsy. Only the first time an "admitted contributory disability" is reported will it be taken up as "ACD." All subsequent entries to the sick list under the same diagnostic title will be taken up as readmissions ("RA"). However, a second or third reaction from neoarsphenamine when due to a new *course* of treatment, will be taken up as "ACD" and not considered as a recurrence of the previous reaction.

One admission to the sick list may be followed by several "admitted contributory disabilities," as in the following case: Patient was admitted with measles, the measles being complicated by broncho-pneumonia and otitis media, acute. Later the patient was taken up under bronchitis, chronic, and finally admitted for deafness. Broncho-pneumonia is an "ACD" of measles; otitis media, acute, is an "ACD" of measles; bronchitis, chronic, is an "ACD" of broncho-pneumonia; and deafness is an "ACD" of otitis media, acute. Many medical histories depict just such a chain of developments, and con-

necting the "admitted contributory disabilities" calls for the particular attention of the medical officer. The proper entries in some of these cases are quite apparent, but in others can be decided only by the medical officers attending the cases. When possible, the cases reported as "A," which should be "ACD," are corrected in the bureau, but a number must be returned to the field for review and verification, the only object being to keep the statistics as accurate as possible.

The following cases were reported as original admissions ("A ") under the first-mentioned diagnostic title, but, upon review and verification, the "A" was corrected to "ACD," the patients having been previously taken up under the second diagnostic title, which was the primary cause of the later disability; abscess (operation scar), right side abdominal wall, "ACD" of appendicitis, acute; abscess, peritonillar, "ACD" of tonsilitis, acute; adhesions, pleura, "ACD" of pleurisy suppurative; anaphylaxis, antistreptococcic serum, "ACD" of erysipelas, the serum having been administered in treatment for erysipelas; anemia, simple, "ACD" of poisoning, lead, acute; appendicitis, chronic, "ACD" of appendicitis, acute (even though the acute and chronic forms of a disease carry the same diagnosis number, 304 in this case, the patient's first admission under the chronic form, following one or more acute attacks, should be "ACD"); arthritis, chronic, ankles and feet, "ACD" of tonsilitis, chronic; cellulitis, right great toe, "ACD" of ingrowing nail; cicatrix, skin (site of right rectus incision), "ACD" of appendicitis, acute; contracture, digital sheath, middle finger, left hand, "ACD" of wound, lacerated, left middle finger; contracture, right axilla "ACD" of lymphadenitis, right axilla; dementia paralytica, "ACD" of syphilis; dermatitis, venenata, salicylic ointment, "ACD" of trichophytosis (the ointment having been applied in treatment for the trichophytosis); fistula in ano, "ACD" of abscess, ischiorectal (patient having been operated on for the abscess); hernia, recurrent after operation, inguinal, "ACD" of hernia, inguinal; hernia, ventral, "ACD" of appendicitis, chronic (patient had been operated on for appendicitis); hydronephrosis, "ACD" of calculus, kidney; mastoiditis, acute, "ACD" of otitis media, acute; orchitis, acute, "ACD" of mumps; pleurisy, serofibrinous, "ACD" of contusion, multiple, head chest, shoulder, and pelvis; rheumatic fever, "ACD" of tonsilitis, acute; stricture, urethra, "ACD" of gonococcus infection, urethra; tonsilitis, chronic, "ACD" of tonsilitis, acute; union of fracture, faulty, "ACD" of fracture, compound, third left metatarsal; valvular heart disease, combined lesions, aortic and mitral, "ACD" of rheumatic fever.

Should there be a previous admission under another diagnostic title which was really a symptom of the present condition, the present condition not at first having been recognized, the patient should be readmitted under the previous diagnostic title and the diagnosis changed, on account of error, to the present disability. Thus, if a patient is admitted under enteritis, acute, and a few days after returning to duty is taken up under appendicitis, acute, the enteritis was probably a manifestation of the appendicitis and if so decided by the medical officer, the case should be readmitted ("RA") under enteritis, acute, and changed, on account of error, to appendicitis, acute. In adjusting the case in the bureau the original admission ("A") under enteritis, acute, will be changed to appendicitis, acute. The case will then appear in the Annual Report of the Surgeon General as one admission under appendicitis, acute, instead of two admissions, one under each diagnosis.

In addition to the instances previously mentioned, readmission ("RA") is used in the following: The established diagnosis when change has been made from diagnosis undetermined; the subsequent diagnosis when change of diagnosis has been made on account of error; taking up patients from transfer. Rarely, in cases of injury, it is found necessary to report one case under more than one injury title, using the designation "RA" for injuries received in different parts of the body. This rule is desirable in order that one accident may be represented by only one original admission to the sick list. If possible, a more comprehensive title should be selected, the case reported under the graver injury.

On Form F cards there appears one other designation not yet discussed—"remaining from last year"—which is used for cases that were admitted in the previous year and continued on the sick list into the present year. The two Form F cards required to report these cases will carry the same date on line 7, but each card reports only the sick days of the year it covers. If a patient is taken up 12-5-29 and disposed of 1-5-30, the first Form F card will have 12-5-29 entered on line 7 and continued, "—," 12-31-29 with 26 sick days entered on line 8; the second Form F card will have remaining, "—," 12-5-29 entered on line 7 and disposition 1-5-30 with 5 sick days on line 8.

Line 14 of Form F card, "Other data and remarks," can be most helpfully employed in giving information concerning the manner of taking up cases. For instance, a patient is admitted with neuritis, optic, and transferred to a hospital, where it is later discovered that he has syphilis, and a change of diagnosis is made to a concurrent syphilis. If the neuritis, optic, is of syphilitic origin, a statement to that effect under line 14 on the Form F card reporting the change

of diagnosis will inform the bureau that the original admission, "A," under neuritis, optic, must be changed to "ACD" with syphilis as the primary condition. Again, when a patient is admitted with arthritis and a change of diagnosis is made to tonsillitis, chronic, if the tonsils are the focus of infection causing the arthritis, such a statement could be made under line 14. This information would be most useful, since all the Form F cards for one individual are reviewed as a case; that is, the F cards carrying dispositions "T" and "C" are held until receipt of the F card carrying the disposition discharging the patient from the sick list. Adjustment for statistical purposes may then be made after all diagnoses are reviewed in relation to each other. When the health records concerned are on file in the bureau at the time of reviewing cases the information can be obtained from reading the medical history sheets. One of the larger hospitals makes use of line 14 in stating the date of original infection in all venereal cases. By this means it is immediately known whether the cases have been properly taken up. In cases of injury this space has its specific use for injury classifications, but in diseases it is simply used for giving any information which may be considered of interest or value to the bureau in reviewing cases.

Before being forwarded to the bureau, Form F cards should be most carefully checked against the medical history sheets and medical abstracts to assure that the proper manner of taking up was used, and also that they agree with the history sheets in diagnoses and dates upon which diagnoses were changed.

Upon the accuracy of these reports depends the accuracy of the vital statistics published in the annual report of the Surgeon General.

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#### AN IMPROVEMENT IN THE DIET FOR SUBMARINE CREWS

By B. H. ADAMS, Lieutenant, Medical Corps, United States Navy

In considering the diet for a submarine crew for a cruise of more than five or six days it will be found that the one article difficult to furnish is bread.

Fresh bread taken aboard will last approximately five or six days. After this period it becomes necessary to have biscuits, hot breads, etc. This type of bread, though appealing to the crew, can not be considered ideal for a submarine. The men are unable to secure the usual amount of exercise, and the result is gastrointestinal disturbance and constipation.

In seeking to fill this vacancy in the menu several breads were considered. Zweibach was found to have excellent keeping qualities, but being sweetened, soon becomes unpopular with the crew. Crackers are relished with soups, but can not replace the need for bread.

In considering the use of dehydrated bread, a test was made by slicing two loaves of fresh bread, subjecting the slices to slow heat until dried, and, after wrapping in brown paper, allowing the slices to remain on board a submarine during an 11-day cruise. When examined after this period the bread was found to be unsuitable for food, as the oily odor had penetrated the package.

The experiment was repeated, this time packing the slices in paper cartons, and sealing in a double layer of waxed paper. A package was prepared in this way, containing six loaves of dehydrated sliced toast—an amount sufficient for 32 men at one meal. It was kept on board a submarine for 10 days. When examined at the end of this period it was found to be free from oily odors, contained no change in its dryness, and was quite palatable.

Fourteen of the submarines basing at the submarine base, Pearl Harbor, Territory of Hawaii, were ordered on a two months' cruise to San Diego, Calif., and return. A supply of the dehydrated toast was furnished each boat. Half of the total amount was white bread and half whole wheat. The trip to San Diego took 16 days and the return trip 11 days. The former was very rough cruising. The commanding officers of the submarines, when interviewed, were enthusiastic about the toast and felt it was of considerable value in keeping the crew in good condition. The number of complaints of constipation was noticeably lessened.

The toast was sprinkled with water and re-toasted by many of the cooks and made a good fresh crisp toast. It is now believed that if this toast were put up in sealed tin containers, it would be excellent for a portion of an emergency ration. Extra care had to be used in handling the cartons, as any break in the waxed paper meant contaminating the contents by the penetration of oily odors. It is proposed to keep some of the cartons in stowage to determine the length of time they may be kept and still be palatable.

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#### MEDICAL MYCOLOGY<sup>1</sup>

By G. W. COOPER, Lieutenant, Medical Corps, United States Navy

#### ASCOMYCETES

The following genera are of primal import and are given in the approximate order of frequency of occurrence. Most of the parasitic molds of medical importance other than the Hyphomycetes are in the class Ascomycetes. The distinctive characteristic is the formation of ascospores in diminutive sacs or asci. Conidiospores are also usu-

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<sup>1</sup> This is the last of three lectures delivered at the Naval Medical School in November, 1929. The previous lectures appeared in the April and July, 1930, numbers of the BULLETIN.

ally formed. Both are asexual. The botanical classification of this class is by no means final since many of the Deuteromycetes are believed to be but hyphomycete stages in the life cycles of the ascomycetes.

1. Trichophyton and the Epidermophyton.
2. Achorion.
3. Microsporum (or Microsporon).
4. Aspergillus.
5. Penicillium.
6. Saccharomyces.
7. Endomyces.
8. Cryptococcus.

**Epidemiology:** As a rule the spores of trichophyton and epidermophyton are not killed by boiling, drying, or antiseptics.

**Trichophyton:** The fungi of this genus are the megalosporons or large-spored ringworms. As a rule they are easier to cure than the small-spored types or the microides (microsporon). Many of them are derived from dogs, birds, horses, and cats, especially the latter two, and are rather easily transmitted to man. But, like most fungi, they are often inoculated from man down the scale to lower animals in the usual laboratory experimental work with considerable difficulty. The endothrix types are of human origin only and the mycelium develops only inside the hair shafts and does not cause suppuration.

The spores of trichophyton vary from 3 to 15 microns and are arranged in chains and may be either inside (endothrix) or both inside and outside the hairs (ectothrix or endoectothrix). The two latter groups are of animal origin and are often pyogenic. There is a third smaller group which does not attack the hair or hair follicles or cause suppuration. This group is uncommon and contains but four species.

Most of the scalp, face, and hairy part ringworms belong to the *T. megalosporon* (Sabouraud) strains.

*T. megalosporon endoectothrix* of Sabouraud—also known as *T. mentagrophytes* and *T. asteroides*.

**Diagnosis:** The lesions are often of acute inflammatory type and sometimes suppurating. Scalp involvement is more apt to be *T. tonsurans*, while the *T. megalosporon* causes most of the face and body cases. When the latter is pyogenic it causes the conditions known as sycosis, kerion, or a pustular tinea corporis.

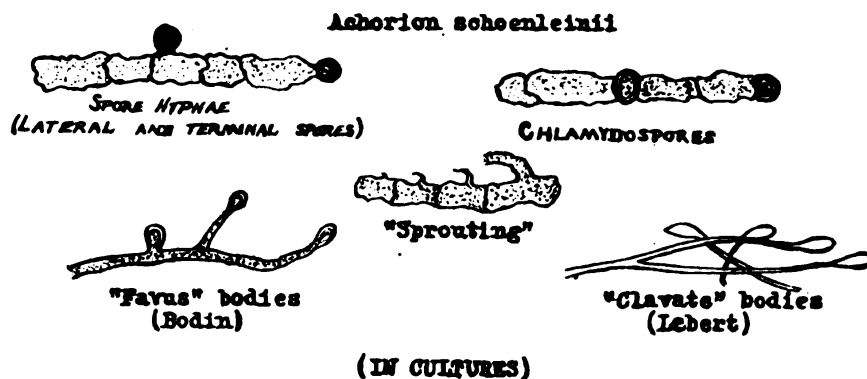
Pull out the hairs from the periphery of the lesion rather than the dead central ones. Mount hair direct in 10 or 20 per cent sodium hydroxide. Also mount a specimen in lacto-phenol solution as outlined in lecture 2. Culture on Sabouraud's maltose and glucose.

This trichophyton is of animal origin; horses, cows, and dogs.

**Morphology:** The colonies are finely rayed. Radiating furrows are seen, giving the name *T. asteroides*. Some cultures are white, yellow, or rose colored. On Sabouraud's agar the growth is white. The center is raised and sprinkled with down. Most of the growth shows a powdery surface. Several radiating furrows are often seen. The presence of spiral bodies, conidia and spindles in cultures is diagnostic.

The external spores are in chains or end to end and vary widely, from 7 to 15 microns. The internal spores are few in number and are smaller, 5 to 6 microns in diameter. Both of these are the misnamed "mycelial-spores," but are vegetative units.

**Treatment:** X ray, tincture of iodine, Whitfield's ointment, Deek's ointment, methylbenzene, salicylic acid in alcohol or ointment, chry-sarobin, 10 to 20 per cent aqueous sodium hyposulphite, Castellani's anilin red paint, etc. Ultra-violet ray and heliotherapy are valuable



in resistant cases. Water solutions of volatile aromatic oils as clove, cinnamon, thymol, etc. For this foot mycosis, Pusey (20) uses metaphen (1 to 500) and wet dressings of aluminum subacetate (8 per cent); after the acute stage, potassium permanganate (1 to 3,000) is used.

**Trichophyton tonsurans:** Causes most of the large-spored scalp and many of the body ringworms, tinea capitis and tinea corporis, respectively. It is reported uncommon in England, but is endemic in certain areas. Synonym: *Trichophyton megalosporum endothrix* of Sabouraud.

**Diagnosis:** The fungus is wholly inside the hair. The hairs are broken, short and mouldy in appearance. On the face the lesions tend to break down and are often known as sycosis. Make slide preparations in 10 or 20 per cent sodium hydroxide. The large-spored ringworms can usually be cultured but not always. Culture on Sabouraud's maltose-peptone-agar. It grows well on maltose agar and most sugar media. Maltose agar colonies are white or

yellowish, crateriform, with an early velvety surface and later a profuse down or powder develops.

As in many species, hanging-drop cultivation must be made to see the spore-bearing organs which are delicate.

**Morphology:** The spores are 4 to 6 microns in size. The mycelium is segmented and, as in other endothrix and endoectothrix trichophytions, spores are produced inside the mycelium. It is a true endothrix. The end-to-end mycelial cells are the so-called mycelial spores of the trichophytions but are really vegetative forms rather than spores. They are large and quadrangular or rectangular.

**Pathology:** Besides the tinea capitis and tinea corporis this species may rarely cause a trichophytosis of the nails.

**Achorion schonleinii:** This mold is the cause of favus and is also known as tinea favosa. It is a contagious skin disease although not so contagious as ringworm.

**Diagnosis:** The scalp is usually involved but the finger nails and any part of the body with hair follicles may be involved. Loss of hair usually results. Glabrous parts are less often involved.

The "favus cup" or scutulum is diagnostic. This is a yellow, round, cuplike crust with the odor of mouse urine and resembling a honeycomb. There are many situated over hair follicles although affected hairs may not show a cup. A broken, dull hair is seen in the center of most cups. There is intense itching and a peculiar moldy odor. The mold may affect hairy or nonhairy parts. It may also attack the nails.

Mount slide preparations in 10 or 20 per cent sodium hydroxide. Culture on Sabouraud's maltose. Pleomorphism develops early. To prevent this, culture on conservation medium without sugars.

**Morphology:** Gross appearance of colonies is wrinkled with ridges or convolutions. It is bulging and resembles a sponge (Sabouraud). The colonies are yellowish-white, as the color of Loeffler's medium. With age, the usual pleomorphism and fine down appears.

Mycelium and spores show great irregularity. The former is apt to show "sprouts" at intervals (since reproduction takes place by sprouting and spores), is tangled, irregularly scattered, wavy instead of straight, as are the trichophytions, and varying in length and thickness. The mycelial threads often divide into 3 or 4 branches, ending in a single row of round spores. The spores are refractile, gnarled, and of bizarre shapes, while those of the ringworm are regular ovals or spheres. This is because of multiplicity in the configuration of spores. Chlamydosporelike bodies are known as "yellow" or "favus" bodies, and are usually terminal, or double contour, and granular in structure. Terminal, spatulate, single-contoured, non-septate, sporelike bodies occur and are known as claviform bodies.



Their true nature is unknown, but they appear to be closely analogous to the terminal mycelial "spindles" of the trichophytons and microsporons.

**Biologic relationship:** The *Achorion schoenleinii*, then, is an interesting species because of its varied and unique picture, which is based directly upon the peculiar mechanism of fructification of the genus Achorion. The clavate terminal processes of mycelial hyphae in cultures closely resemble the terminal spindles of epidermophyton, trichophyton, and microsporon, but true spindles are septate, thicker, and are fusiform. These claviform bodies must be given a specific name and a new genus formed. This is an example of how the new genera are built up, very often, perhaps too frequently, upon purely morphologic differences.

In the second place, the terminal "yellow" or "favus" bodies are considered true chlamydospores by most writers, but still there remains some doubt about their true nature. The protoplasm of mycelial terminal filaments in cultures becomes collected at the distal end, which dilates to ovoid or roundish contour and develops a double contour. The proximal ends of these distal segments become thinned out and the protoplasm becomes granular.

**Conidia:** In this, and the usual achorions of human origin, there are in cultures no conidia-bearing hyphae; those of animal origin show conidia and some of these show also the typical septated "spindles" of the trichophytons, epidermophytons, and microsporons, and in this respect merge into these genera. It is rather the rule in mycology to have one genus show gradual change by small gradation to the border-line species, and gradually then to "within the sphere of characters" of the neighboring genus.

**Pathogenicity:** Pure cultures produce the favus lesions by inoculation in man, dogs, mice, rabbits, and fowls. Inoculation in guinea pigs do not give typical favus but give a circinate trichophytic lesion.

The trichophytons, in general, are just about as easy to inoculate into laboratory animals and get tissue response as any of our fungi. Many of them have been inoculated successfully. The epidermophytons, the nearest related genus, are most unresponsive in this respect, and all of them, except one species isolated from monkeys by Pinoy, are of human origin. Pinoy's *E. simii* is the only species recorded as inoculable into guinea pigs.

The achorions then are really trichophytons with long mycelial segments making up the filaments and these terminate in a single row of round spores in the tissues. The mycelial threads may divide into three or four branches. The segments are longer than in the trichophytons, microsporums, and epidermophytons. They are also

more ragged in contour in the achorions, which latter also show the terminal tissue spores to be irregularly distorted.

*Microsporon audouini*: This is one of the "microsporons" or small-spored ringworms and is also known as *Microsporum audouini*. It is said to cause one form of alopecia areata. It is very common on the scalps of children in France and England but less so in other countries. It is highly contagious.

Diagnosis: There are no yellow favic scutula formed. It can almost be excluded in the Tropics, as it practically never occurs there. It is very rarely seen on glabrous or parts other than the hairy scalp. A white opaque sheath is formed by the chains of "mycelial spores" on the outside of the hairs, the broken stumps of which are characteristic. These round or polyhedral spores form mosaics around the hairs.

Mount slide preparations of the deep scrapings of the lesion in 10 or 20 per cent sodium hydroxide. Be sure to include one or more hair stumps. Attempt culture on Sabourand's maltose agar. It grows well but slowly on this and other media. Growth develops in about one week and is mature in six to eight weeks.

Morphology: The colonies are snow white and of downy texture.

The spores, 2 or 3 microns, are packed in mosaics or sheaths on the outside of the hairs, giving them a white membranous envelope. The spores are uniformly small. Aerial hyphae develop early in artificial media (10 days) and show terminal or lateral conidia of the Alcadium type. Reproduction also occurs by chlamydospores, sprouts from mycelial threads, and by septate or non-septate "spindle" conidia.

*Aspergillus fumigatus*: Formerly thought to be the cause of pelagra before the work of the late Dr. Joseph Goldberger. It is now known to be the cause of a lung mycosis, clinically resembling tuberculosis.

Diagnosis: The aspergillus lung disease is to be differentiated from *Cryptococcus gilchristi* and *Coccidioides immitis*. This may be done by direct smears or cultural methods.

The *gilchristi*, like the other species of cryptococcus, has a double contoured membrane and reproduces by budding. On smears from the lungs it appears as a yeastlike cell closely allied to the blastomycetes. It is rather uniformly round in form and about 16 microns in diameter. While it may invade various viscera, it commonly causes a dermomycosis, the lesions resembling the infectious granulomata. Scrapings are made from the skin (after soaking skin 10 minutes with 70 per cent alcohol) and mounted under a thin cover-slip in a drop of lacto-phenol-alcohol solution, as given above. The budding yeastlike cells give the diagnosis. Artificial cultures of the first generation are hard to obtain on the usual Sabouraud's medium.

Löffler's serum often gives results. Growth occurs well at room or incubator temperature. Subcultures are usually grown more readily and quite well on potato, which may also bring out a scant mycelium. Certain strains ferment sugars; others do not. Subcutaneous inoculation of guinea pigs and the recovery of the budding cells from the resulting abscesses is the final test. Ricketts (27) has reported 17 strains with minor differences.

This *gilchristi* infection is sometimes referred to in texts as "oidiomycosis" or "blastomycosis." The latter term is more nearly correct although both are inexcusable. Brumpt called the organism *Cryptococcus hominis*. It is to be greatly deprecated that the terminology in mycology is in such a confused and loosely applied state. Mycology, especially, seems to be burdened by overlapping and ambiguous terms. The result is almost an endless task for the student. But one term alone should be used for a pathologic entity. It is hoped that we will soon have a Determinative Manual of Mycology along the lines of the Manual of Bacteriology by the Bergey committee of the Society of American Bacteriologists.

The *Coccidioides immitis* lung infection is much like the *gilchristi* and the *aspergillus* in its clinical manifestations. It resembles phthisis of the lungs and often becomes generalized. The cases are uncommon and are usually reported from California. An excellent case report, with considerations of diagnosis and treatment, is recorded by Ragle (21) in the Naval Medical Bulletin of July, 1929.

The cell is a large yeastlike body, 20 microns in diameter, and showing no mycelium in the tissues, which latter is also true of *gilchristi* but does not obtain for the lung *aspergillus*. The large yeastlike cell often shows other smaller bodies within the parent cell; these are endogenous spores. They are never seen in the *Cryptococcus gilchristi* or the lung *aspergillus*. Then too, *Coccidioides* grows well on artificial media containing carbohydrates and becomes brown with age.

Morphology: The *A. fumigatus* has a mycelium with erect bulbous spore hyphae (or columella) which bear innumerable conidia, in chains on single slender closely packed pedicles (known as sterigmata), and arranged fan-shaped on lateral view. The conidial aerial hyphae are thicker than the mycelial tubes (5 microns). The conidiophores may be branched, two on the same aerial hypha, or unbranched. Mycelial threads are 2 to 3 microns thick and may show lateral or end branching and the branches may show bulbous ends without spores. The conidia are round, smooth, colorless, and 2 to 3 microns in diameter.

Cultural: This species grows well on ordinary media, greenish on acid and brown or black on neutral or alkaline medium. It is mesophilic.

**Incidence:** It is the commonest aspergillus and found on straw, hay, etc. Bovo, in Italy, reported a case of black Mycetoma of the foot which he considered due to *A. fumigatus* but cultures were not taken and the case remains problematic.

**Penicillium:** This genus is much less important than the somewhat similar aspergillus met with in the practice of medicine. Chains of the simplest type of fungous spores (conidia) are found in strings upon the vertical branches (conidiophores) which give the fructification bodies a brushlike or broomlike design. Thus, it takes its name from the Latin, *Penicillum*. The conidia are round or ovoid, smooth, brown in color, and 2 to 4 microns in length. In exceptional cases the penicillium may form perithecia but the typical appearance is that of a human hand with a string of terminal beads on the fingers. Such is the appearance of the common *P. glaucum* which might be taken as the type species. The penicillium most commonly seen, perhaps, is the common household blue-green mold, also known as *P. crustaceum*. At least two authors consider it pathogenic in some cases of otitis media, nasal and eustachian catarrh and one in gastric hyperacidity.

**Incidence:** A very common saprophyte found on leather, fruits, bread, cheese, etc.

**Cultural:** It grows well at a wide range of temperatures (2° to 37° C.) on ordinary media and is very resistant.

*P. montoyai:* This causes a violet "pinta," a skin disease showing various-colored spots on the skin, and found in Mexico and other tropical countries where it may also be known as "pinto" or "Mal de los pintos" or spotted disease. It resembles psoriasis but it is contagious. Other types of pintos are caused by similar species of penicillium and also by aspergillus and monilia.

*P. montoyai* has the morphologic characters common to other species. Conidia are round or oval, smooth, 3 to 5 microns.

**Cultural:** Grows well on ordinary media and forms a dark grayish color.

*Penicillium barbae:* This species has been found growing upon the beards of natives in equatorial Africa and in Ceylon by Castellani and Chalmers. They do not record cultural or morphologic studies.

*Saccharomyces cerevisiae:* This is the ordinary yeast fungus. In addition to its commercial and domestic uses it is employed as an antiseptic to combat intestinal putrefaction, stasis, and autointoxication, and because of its high vitamine content in the treatment of beriberi and other food-deficiency diseases.

Various species of yeast are found in the air, soil, and water. For example, various strains of torula or wine yeasts are found in the

soil. But, also, there are strains of torula which are reported as pathogenic for man. Alvarez (8) reports a red torula infection of the human tongue. The tongue presented the soft, furlike "hairs" of the hypertrophied filiform papillae as in the two cases of "Black Tongue" reported by Wells and Cooper (9), but the pigmentation was diffuse, bright red instead of black.

The yeasts likewise show properties of pathogenicity and are then known as blastomyces.

Diagnosis: Differential diagnosis is to be made between the benign types or *Saccharomyces* and the pathogenic types or *Blastomyces*. This is often a difficult problem since the blastomycetes, as is true of most fungi, very commonly give little if any response in the laboratory animals while causing the problematic lesion in the human. Pathogenicity studies of any fungus, if negative, are always meaningless.

Direct smears from the problematic lesions or sputum should be made for gram stains. Wet preparations of the material should be made in the lacto-phenol-alcohol solutions and covered with a thin cover slip. The yeasts and yeastlike organisms usually stain gram-positively. Diagnosis is largely made on size, contour, and capsule of the cells. Some distortion of contour may result from fixing and staining so that the wet preparation is used as a check in morphologic studies, the lacto-phenol-alcohol solution being employed to prevent swelling, shrinking, or distortion of fungi in general. The more common 10 or 20 per cent sodium hydroxide solution may be used for the wet preparations, especially when a large débris of tissue is present in the scrapings or sputum, but there is apt to be some change in size or shape of the fungous cell due to the hydroxide.

*Saccharomyces* and *Blastomyces* must also be differentiated microscopically from the *Cryptococcus*, *Pityrosporum*, *Torula*, and *Mycoderma*.

The cryptococcus species have double contours and are round or oval with smaller dimensions, as a rule, than for the *saccharomyces* and *blastomyces*, which both have single-contoured peripheral margins. Pellicle is formed on fluid sugars by *cryptococcus* and *pityrosporum*, but it is not so thick as for the *torula*. Records of sugar reactions for these related genera are so fragmentary as to be of little aid in diagnosis.

Certain vegetative forms of *cryptococcus* with single contoured borders have been reported under the name *Pityrosporum*. The writer has been unable to observe any such forms in the work on this genus. It is as yet not a recognized genus.

The cell body of *torula* contains a large globule of fat. No air bubbles form in the pellicles upon fluid sugars. The cell is oval or

round and often shows two or more bud processes at one time. Pigment is usually formed. Otherwise it resembles the cryptococcus.

Mycoderma shows early formation of a very thick pellicle containing bubbles of air or gas. The vegetative cells are markedly elongated.

Gross appearance of colonies and cultural studies of the yeasts and yeastlike species are given in detail in reference 10. There are many strains of benign yeasts, each displaying distinctive fermentation of sugars. These may be differentiated from the pathogenic yeasts or blastomycetes by the sugar reactions, microscopic morphologic characters, gross appearance of colonies and the occasional response of laboratory animals to the inoculation of pathogenic species. A special point of practical importance is to smell the odor of the cultures. This simple but helpful test is usually neglected even by experienced workers. The true yeasts show, of course, the distinctive odor of baker's yeast, even in artificial culture. The yeastlike pathogenic forms usually lack this odor.

The fluid sugar fermentation reactions of the benign yeast cell are often confusing and show rather wide variation according to the strains dealt with. According to Hansen (11) there are five main groups. Group 1 shows acid formation on dextrose, maltose, and saccharose; group 2 on dextrose and saccharose; group 3 on dextrose; group 4 on dextrose and maltose; group 5 shows no acid formation on any of these sugars. Groups 4 and 5 are uncommon.

Differential diagnosis of strains of yeasts is also made by determination of growth-ages and thermal points for pellicle-formation and sporulation. Thus, a film is formed on fluid sugars by the *S. cerevisiae* in 9 to 18 days at 33° to 34° C.; sporulation occurs in 24 to 48 hours at 25° C. and at 20 hours at 30° C. As the temperature of cultures is decreased, the time required for pellicle formation is increased up to 2 or 3 months.

*Endomyces vuillemini*: This is one of the causes of thrush, on tongue or buccal surfaces, with the formation of a false membrane. This membrane is easily detached, as in monilia thrush, leaving an intact mucous membrane.

*Diagnosis*: An unknown fungus which grows in alkaline medium can probably be ruled out as being the *E. vuillemini*, as this organism is recorded as growing only in an acid medium. Differential diagnosis involves practically only the *Monilia albicans* or other strains of *Monilia*. The resemblance of the two genera is close, and some authorities consider them identical. The *Monilia albicans* (*Oidium albicans*) does not show the endospores or asci of the endomyces. There are at least 40 known species of *Monilia* (Castellani) and 4 recorded pathogenic species of *Oidium* (Pinoy). Fer-

mentation tests for acid and gas production on the various sugars, alcohols, and glucosides will aid in differentiating these 44 species from the endomyces.

*Morphology:* A profuse mycelium is observed with spores in the interior of the filaments. Small sacs or asci are also formed and these contain the spores or ascispores. Chlamydo-spores are also formed at the sides or ends of the hyphae.

*Treatment:* Alkaline solutions. Do not use boric acid, as the endomyces grows only in an acid medium and, like the *Monilia albicans*, has been actually observed to grow in boric-acid solutions.

Aqueous gentian violet solution (1 per cent) as developed by Faber and Clark (5) at Stanford Hospital for *Monilia albicans* thrush is also recommended.

Plimmer's bodies, observed in certain cells of carcinomas, sarcomas, and some benign tumors, are regarded as yeastlike parasites by some, but are probably artefacts. Their true nature is undetermined. The character of the small bodies in the cells of *Molluscum contagiosum* is likewise unknown. They have been reported as yeast cells, but are now thought to be artefacts.

In closing the discussion of yeasts and yeastlike fungi it is interesting to note that, although some species do not show asci formation, certain authors classify the yeasts in general as of an order of the fungi considered of the phylum Thallophyta. The Lichenes and Algae are thus two other subdivisions of this phylum. The Lichenes are more recently regarded as included in the subdivision of sub-phylum Fungaceae. They resemble the Ascomycetes in their mode of a sexual reproduction and usually live in symbiosis with an alga, deriving organized food from the algal cells, and, in turn, protecting them from injury or exposure by enveloping them with their hyphae. They are rarely basidiomycetous. The lichens have a flat or branching thallus not differentiated into stem or leaf. Many of the lichens are of industrial value, furnishing various dyes and articles of food. Some of these species are the source of commercial litmus used in making litmus paper. Others are the archil species which are the sources of archil violet, persis, and cudbear, the latter a reddish powder with which you are probably familiar in the field of pharmacy. The Iceland lichen or Iceland moss is an edible moss found in the Arctic regions and down to the North Temperate Zone. It yields a nutritious jelly and has been used as a demulcent in remedies for pulmonary diseases. The reindeer moss, another species of lichen, forms extensive patches on the ground in the Arctic and north temperate regions and is the principal food of the Lapland reindeer in winter. The lichens are perennial and grow very slowly, but attain an extreme age. Some species growing on the rocks of the

highest mountain ranges are estimated to have attained an age of 1,000 years. In short, lichens are fungi symbiotic with or parasitic on algae. Then, again, certain fungi of the class *Phycomycetes* are described as "algae fungi" because of their distinct structural resemblance to some algae.

The algae, almost without exception, contain chlorophyl and are not apt to be confused with the fungi or lichens. The term "algae" has developed to be a convenient popular designation of the seaweeds and cellular fresh-water plants in general. To the botanist it signifies a class of the phylum *Thallophyta*, but even this concept of classification is by no means final.

The most complete work summarizing the early knowledge on algae is the *Flora Europaea Algarum*, by Robenhorst, in 1868. To acquire the historical insight into the work done on this continent one must also consult the *Fresh-Water Algae of the United States*, by Francis Wolle, 1887.

#### PHYCOMYCETES

The class *Phycomycetes*, like all true fungi, do not contain chlorophyl. This order is of much less medical importance than the *Ascomycetes* or the *Hyphomycetes*. Only four species are reported of pathogenic significance and most species are encountered as contaminations in work with other fungi, resembling, in this respect, certain of the *Ascomycetes*.

There is a profuse mycelium of interlacing threads, the latter being, as a rule, nonseptate. Reproduction is sexual and also asexual by the formation of true conidia or by fungous spores within a sporangium or spore-case borne on the end of an aerial hypha. The clubbed end of this aerial hypha is known as the columella and projects into the sporangium. Reproduction of the sexual type is by heterogamy in several species but these are of no medical importance. Several of the more important species of medical significance reproduce both by isogamy and by the asexual typical sporangial spores; these are of the subclass *Zygomycetes*, order *Mucorales*, family *Mucoraceae*. The *Mucoraceae* is the only family of medical importance. The component genera are to be remembered in the following order: *Mucor*, *Rhizopus*, and *Rhizomucor*.

At times the nonseptate mycelium of these genera, when under anerobic conditions, may break into short fragments resembling yeasts or bacteria.

*Rhizopus niger*: This mold has been considered the cause of one form of black tongue, fungoid type.

Abundant rhizoids extending down from the mycelium produce a snowlike or cottony mass. It can scarcely be mistaken for any other



fungus. Ciaglinski and Hewelke isolated it from a case of human black tongue.

These same authors, and later, Seniysiak, have reconfirmed the status of black tongue due to the *Rhizopus niger*.

*Mucor mucedo*: Like all of this genus, there are no rhizoids present. The mold is usually seen in the external body cavities, auditory canal, and nasopharynx, but lung and generalized infections have been reported.

**Morphology:** Various strains, as is especially true of trichophytons, show spores of different sizes. As for the trichophytons, the smaller spored strains are more pathogenic and resistant to treatment than the larger. The organism usually shows a dense, rather coarse, cottonlike mycelium. The spore case or sporangium contains the spores and projects on the columella of an aerial hypha. *M. mucedo* has a silver-gray mycelium and a large sporangium, 150 microns in diameter. The spores are oval and 5 by 9 microns in size. Very large zygosporangia are sometimes seen.

*Mucor corymbifer*: Develops also in the external body cavities. Several cases of mucormycosis of the ear and nose are reported in the literature. Several species of Mucoraceae may cause these infections. *Lichtheimia* (*Mucor*) *corymbifera* is almost always found. Two cases of *M. ramosa* are reported by Castellani and Chalmers. The rôle of these mucors is not finally demonstrated as to pathogenicity.

**Morphology:** The mycelium forms a dense, coarse, snow-white growth. Later it is yellow. The sporangia are small and pear-shaped, 20 to 40 microns, and the spores about 3 microns in diameter and oval in shape.

Mucormycosis of the lung is a rare condition. Two cases have been reported in which the *L. corymbifera* was found at autopsy in hemorrhagic areas in the lungs.

*Rhizomucor parasiticus*: But little is known of this species. The early mycelium is gray and, later, brown. It is pathogenic for guinea pigs and rabbits (Castellani). It has been observed in the sputum of a woman presenting the signs and symptoms of phthisis. Rhizoids are present at the base of sporangial hyphae (1 to 2 cm.). Lucet described a case of bronchitis due to this species. The sputum was bloodless, scanty, and mucopurulent. Mycelial threads and oval spores (4 by 2.5 microns) were present. The fungus was grown on culture medium. The condition subsided after six months' treatment with iodides and arsenic.

*Rhinosporidium seeberi*: Soft, vascular polyps, affecting usually the mucosa of the nose, are the pathologic process resulting from infection by this mold. The condition may also invade the ear, lachrymal sac, and membranes of the mouth.

Seeber first reported the disease in 1896. Cases have been reported in the Argentine, India, and the United States.

There is a protracted course over 10 or 15 years and a marked tendency toward recrudescence.

Conclusive reports of cultivation are not on record, while the pathogenicity studies in animals are inconclusive. Transmission is thought to be by direct contact and implantation of the spores.

Morphology: The picture, upon sectioning the polyps, is that of round spores or sporangia, 6 to 300 microns. The larger spheres contain hundreds of spores which are released when the mature spore case ruptures. The immature, vegetating cell thus formed has a large, vesiculated nucleus and may spread the process by reimplantation.

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#### MYCOLOGICAL NOMENCLATURE AND METHODS

Sabouraud's maltose agar is as follows:

Maltose.....	4.0 (Chanut's French Maltose)
Peptone Chassaing.....	1.0
Agar.....	1.50
Distilled water.....	100.0

Practically all trichophytons and certain species of other genera become pleomorphic on maltose or other sugar agars. That is, they lose their original characteristics of the young cultures and will never return to the primal state in subsequent subcultures or even by animal inoculations. Organs of fructification are now usually absent and the colonies are covered with a profuse white down. Trichophyton sabouraudi is an exception to this pleomorphism of degeneration.

To circumvent this morphic variation we have come to use what is known as Sabouraud's conservation medium for the maintenance of fungi in the laboratory. The fungi grow much less abundantly on this than on sugar media, but they remain fairly characteristic and show but slight, if any, pleomorphism. The formula is:

Agar.....	1.8
Peptone Chassaing.....	3.0 to 5.0
Water.....	100.0

Fungi are rudimentary plants not containing chlorophyll or its analogue. Nevertheless, many are pigment producers and most are multicellular. A few, other than the bacteria, are unicellular. The bacteria are considered by some authors to be fungi, reproducing by fission and rarely showing endospore formation. All fungi lack differentiation into stem, leaf, and root, but the higher ones have thallus formation, or network of threads. This network of threads is known as mycelium.

**Perithecia:** These are the envelopes covering the fructification organs of certain species of molds. The flask-shaped organs of the *Claviceps purpurea* (ergot) are perithecia. The term is also applied to the receptacles for the asci in the lichens and ascomycetes.

**Claviform bodies:** These are clavate or club-shaped special organs of reproduction of the genus *Achorion*. Terminal segments of mycelium become swollen. They are nonseptate and more slender than spindles.

**Spindles** are found on the trichophytons, epidermophytons, and microsporons. They are blunt or pointed fusiform bodies or special cells for reproduction. They may be septate or nonseptate. Reproduction of the epidermophytons is principally by the pluriseptate spindles.

**Favus bodies**, known also as yellow bodies, and special organs of reproduction possessed by the achorions. They are granular, double-contoured bulbous projections from the end or side of a mycelial segment.

**Spiral hyphae** (spiral bodies) occur in the genus trichophyton but are absent in the epidermophytons, microsporons, and achorions.

**Pectinate or denticulated segments** of the mycelium are peculiar to the microsporons. These segments are curved with notching on the convex side.

**Conidia:** These are nonsexual and are the simplest type of spore. They arise by budding or septation from the sides or ends of a germinal mycelial hypha or sporophora. Also known as exospores.

**Acladium:** These are blunt, lateral, knoblike conidia on the usual sporophore and are typical of the genera trichophyton and microsporon. In the trichophytons these spores are supported by short sterigmata.

**Ascospores:** These are asexual spores within an ascus or special sporangium. The spores are 4, 8, or a multiple of 8 in number, and are usually placed end to end. Each one shows an internal and external capsule.

**Chlamydospores:** These may develop on the sides of or at the end of a mycelial hypha or may interrupt its course. They are the very largest type of spores, show a thick membrane or double contour and are very resistant. They are asexual and round or slightly oval.

**Monilia and oidium:** These two generic names should not be used as synonyms even in the case of *M. albicans*, where the misuse is most flagrant. They are separate and distinct genera of the hyphomycetes. The monilia produce both acid and gas on various sugars, glucosides, and alcohols, while the oidium species cause only acid fermentation. The genus *Monilia* has now at least 40 species differentiated by cultural studies and Pinoy has arranged the genus *Oidium* to include 4 species pathogenic for man.

The next most common mistake in loose terminology of medical mycology is the interchange in usage of the words "trichophyton" and "epidermophyton." These are two separate and distinct genera and should not be used as synonyms. Certain trichophytons are easily transmitted by inoculation to laboratory animals while but one species of epidermophyton has been transmitted to guinea pigs.

Preservation of specimens: Preparations may be made as by the process used by Macbride for the slime molds. Glycerine jelly has been extensively used for permanent mounting. The specimen on a slide or cover glass should remain in Hantsch's fluid (90 per cent alcohol, 3 parts; water, 2 parts; glycerine, 1 part) for about a half hour to allow evaporation of the water and alcohol. Mounting is now done in the jelly or Canada balsam. Sealing may be done with Hollis's glue or any good cement. Preservation may be made by staining with gram or the Romanowski stains.

Temporary specimens: Simple and rapid microscopic examinations may be made by wetting the material with 90 or 95 per cent alcohol on the slide and next with a weak solution of potassium hydrate, which latter causes the spores and other structures to swell a bit. If desiring further or prolonged study, a little glycerine may be run under the cover slip.

The lacto-phenol method for routine slide preparation of specimens is the one especially recommended. The slide is moistened in its center by a drop of 90 per cent alcohol and the specimen touched carefully to this by means of a right-angled platinum wire. A drop of the lacto-phenol solution is then added and a thin cover slip used. This solution is said to prevent swelling or shrinking of the organisms. Lacto-phenol:

Lactic acid.....	2
Phenol.....	2
Distilled water.....	2
Glycerine.....	4

Specimens may be mounted in the usual 10 or 20 per cent sodium hydroxide, especially when there is tissue débris to be dissolved, but there is apt to be some swelling or alteration in contour of the organism. Pus may be cleared by 40 per cent hydroxide to show the organisms.

Mounting specimens should be done with care with a right-angled hook as the hyphae and other structures are easily broken up. The hanging drop is for this reason preferable to the slide and cover glass.

Diagnosis: Diagnosis of fungi is always a difficult and exacting problem. Diagnoses on the basis of morphologic studies only is always to be avoided if possible, even though it can often be done

with great accuracy. Fermentation reactions should be done on the sugars, glucosides, and alcohols, as most of these tests for the various species are quite distinctive. Attempts at inoculation of the usual laboratory animals should be made, and of special importance is the *Macacus risus*, since this monkey appears to respond to many infections of human origin when other animals are refractive. Weidman and other workers in the latest developments in mycology are now using the monkey whenever other animals show no tissue response.

These three-phase studies should be made when possible, and a diagnosis reached by correlating the morphologic, cultural, and pathogenicity findings.

The criteria for cultural and pathogenicity estimations are obvious. This is far from true in the morphologic studies, especially for the inexperienced worker. In fact, it takes often the most experienced mycologists to appraise properly and give a well-balanced evaluation of morphologic findings, since various characters are often common to different species and even to different genera.

Experienced judgment is required to decide the relative value of structure variations. For example, the size of spores may and should, as a rule, be disregarded. For example, various strains of *Mucor mucedo* show spores of different sizes while it is well known that especially the species of trichophytons vary widely in size of spores from 3 up to 15 microns. The arrangement and structure of spores and fructification organs is a major point in morphologic classification and whether the mycelium is septate or nonseptate at once distinguishes the phycomycetes from the ascomycetes and hyphomycetes. It must be kept constantly in mind that these reproductive organs commonly assume one form when the organism grows in the animal tissues and a definite other form when on laboratory culture media. This is the reason why morphologic diagrams or notes should always be made from the direct stained smears and fresh wet hanging-drop preparations of the animal exudates or scrapings and them again after growth upon Sabouraud's or other media if growth response occurs. This is the most important point for morphologic study and can not be too strongly emphasized, since only by correlation of the two findings is the story complete. For example, the *Coccidioides immitis* of coccidioidal granuloma does not form a mycelium in tissues but appears as round, bicontoured, yeastlike cells, 10 to 50 microns in diameter. These become filled with endospores which, when liberated upon artificial media, will sprout and form a mycelium with aerial hyphae and chlamydospores within and at the extremities of the hyphae in old cultures. These are very resistant spores that develop under new or adverse conditions and they resemble the spherical bodies found in tissues and, if transplanted, will sprout out and grow in the same manner.

The choice of stains is often a helpful detail. Romanowsky stains are advised for this organism, although it takes most of the common stains. Giemsa stain is as good as any.

#### REPRODUCTION

As I have pointed out, the inspection of organs of fructification is our chief guide in the designations or orders of fungi upon purely morphologic grounds.

Even the phycomycetes, while usually showing a 1-celled thallus or nonseptate mycelium, may break up and resemble bacilli or become septate under reduced oxygen tension or during the act of sporulation. For this reason a study of mycelium is often of little or no value.

The phycomycetes reproduce by sexual and asexual spores. Sexual or zygospores and oospores are found and also the conidia, gonidia, or chlamydo-spores. Gonidia are also known as endospores, and chlamydo-spores as endoconidia.

The ascomycetes reproduce by asexual spores (ascospores, endospores, or gonidia) which develop inside special cells or asci. Conidia are also usually formed. The ascospores usually number 4, 8, or multiples of 8. The asci are usually not found during the parasitic life of the fungus which then usually shows conidia (exospores). The ascomycetes are commonly very pleomorphic, varying in form with the medium upon which they live. Since the asci are not found during the parasitic cycle in the tissues, it is most important of all procedures to examine fresh hanging-drop preparations from both the tissues and the culture media and correlate the findings.

The hyphomycetes are also known as the imperfect fungi because the reproductive organs are indistinct and irregular. They propagate by conidia which at times are even lacking.

#### TREATMENT OF MYCOSES

Treatment has been discussed under the subject trichophytosis, since most of our clinical cases seen will prove to fall into this group. This discussion was confined to local infections which are dermomycooses as a rule. Generalized infections are now to be considered.

Treatment of fungous conditions is commonly discussed in a very general way because the clinician believes that they are all to be treated in the same way and therefore is unable to be specific. This is a misconception of the subject and far removed from the truth of the matter. In fact, the same disproportioned viewpoint is often entertained as regards diagnosis of fungi. One often hears the question put by those who should know better, "Why be exacting in the diagnosis when we already know the treatment?"

It is true that there are just about as many treatments for fungous diseases as there ever were for any disease. This is true of all diseases in which ultimate cure is a difficulty. Curiously enough some good results are reported for all of these treatments. This is always true of therapeutic agents against diseases which show a tendency to subsidence and exacerbation in irregular cycles such as the mycoses exhibit. While they may be acute, they are characteristically chronic with varying periods of improvement and flare-up.

It must also be kept in mind that, within certain limits, the fungous infections are self-limiting and a therapeutic agent suddenly employed may be reported as "curing" the disease which "suddenly disappeared." And that is just what is experienced in the history of these infections. A person may have them for years and, as if by magic, they disappear. It is not common for them to cause incapacitating disability or permanent injury, but they may become a living and material torment for the patient. However, death due to lung or other visceral involvement or to mycohemias is common, especially in California in the San Joaquin Valley, where the *Coccidioides* is endemic.

The early lesions can usually be cleared up in the first two or three days by repeated tincture of iodine applications. But this is too strenuous treatment for lesions of the axilla or pudendal and scrotal areas. But one application or often a diluted tincture must be repeated with caution.

As elsewhere prevention is the "golden rule." Normal amounts of body surface oils should be preserved since they appear to protect against fungi. The lesions tend to appear on parts of the body where natural oils are decreased or where stagnation of moisture occurs, as between the toes. It would appear from this that too frequent washing of the hair would dry out the scalp and predispose to the various ringworms. Fungous disease of the scalp is very common, but may result also, of course, by contaminations and the lapse of cleansing measures. It is also well to avoid the use of public baths, showers, and pools, or to wear bathing slippers or wooden sandals. Individual soap and towel must be used. Most important of all is the careful drying between the toes, axilla, and entire body, in fact.

If tincture of iodine does not abort the case there must be immediate change to one of the many fungicides listed under treatment of trichophyton. If not spontaneous, eradication will be often difficult if not impossible. In the infections of the hands or feet the spores are commonly harbored under or around the nails. X ray or heliotherapy may reach these. Curretage or other surgery may be rarely indicated in extreme cases. This is especially true of *Coccidioides immitis* and *Cryptococcus gilchristi* lesions of the ex-

limbs when amputation is indicated in intractable or progressive cases so as to prevent lung or visceral involvement and an almost certain fatal outcome. Especially in these cases of early superficial lesions of coccidioidal granuloma do I wish to emphasize the necessity for early diagnosis by direct smear or culture methods and the Giemsa staining of a plain smear. If you carry this one thing away with you the short course in mycology will be considered well spent. It may prove a life-saving measure some day. The cases are common in California, but have been reported from Arizona, Pennsylvania, South Carolina, Alaska, Florida, and Mexico. There is no systematized distribution. Any of the Romanowsky stains will demonstrate the yeastlike cells in the sputum or skin scrapings. Diagnosis has been discussed in detail above. Early superficial lesions should be treated intensively at once with X ray, ultra-violet, heliotherapy, and by local fungicidal paints (as Castellani's anilin fuchsin) or ointments. If progressively nonresponsive, amputation is absolutely the solution of the problem. Recall also that iodides are without benefit in this disease. We have observed one case over a period of several months in California and could not prove any marked benefit from the iodides in large doses.

But iodides are of value in most other fungous conditions, local or generalized, and it is recommended that they always be employed in visceral or blood-stream infections or when the local superficial lesions are intractable to usual mycocides. The case of *Rhizomucor parasiticus* reported by Lucet is to be kept in mind. The woman had a pulmonary condition resembling tuberculosis and recovered completely after six months of intensive iodide and arsenic treatment. Upon developing iodism she was given arsenic.

Arsenic is of doubtful value, but may be given trial in fungous disease upon the basis of this and other experiences.

The value of iodides, however, is attested by the experience of a great many workers in the field. It is also employed in cases of Actinomycosis and Cryptococcosis.

As to the mycocides for local employment there is little choice, if any. Whitfield's ointment enjoys more common use than the others. It is of value, and contains the active fungicides besides acting by replacing the low or lost skin surface oils which are protective. The latest treatment is a modification of this ointment and contains thymol, thus making therapeutic application of the studies of Myers and Thienes (14) and others such as Kingery and Adkisson (6) on the fungicidal properties of certain volatile oils, thymol, cinnamon, and clove. They are reported as of active value against fungi in the order here named.

The original Deek's ointment has been recently revised to include the volatile oils. The formula is as follows: Menthol 7.0, salicylic



acid 4.0, mercury salicylate 4.0, bismuth subnitrate 10.0, oil of eucalyptus 10.0, oil of cloves 10.0, oil of thyme 10.0, alcohol 5.0, white wax 5.0, lanolin q. s. ad 100. In theoretical consideration it would appear to be a decided improvement. The base of this ointment adheres well to the skin rather than saturating the dressing, has good penetration quality, and is much improved in odor. It is recommended as the latest refinement in local treatment of superficial mycoses.

For mycohemia cases or visceral involvement we also recommend intravenous aqueous solutions of gentian violet and mercurochrome 220 soluble in doses of 5 mg. per kilogram of body weight.

In closing, we wish to emphasize again the grave prognosis of coccidioidal granuloma. About 91 per cent of cases are fatal. Dissemination from skin or other lesions is certain death. Early diagnosis may prevent such dissemination. Very little can be done for the generalized condition. As for *Actinomyces*, potassium iodide is of little, if any, value. Arsenic and vaccines are useless. Tartar emetic appears to be of value; 5 to 10 cc. of a 1 per cent solution is given intravenously on alternate days. It is well to give regular courses of treatment as with nearsphenamine. At the same time the local lesions should receive X ray, ultra-violet, and heliotherapy; the sunlight should be a daily routine. Jacobson (23) reports good results from intramuscular colloidal copper preparations. Best results are by amputation or by excision of superficial lesions.

While the "reservoir of virus" is not known, it is generally felt that the disease is mildly contagious by human contact, exudate from lesions, droplets of sputum, etc. At least semi-isolation precautions should be taken in caring for the cases, and attendants should protect themselves. One student is thought to have contracted the disease by working with cultures in the laboratory. The spores and snowlike mycelium are easily breathed into the lungs if care is not taken. The spores are very resistant to drying, boiling, and antiseptics.

Vaccine and serum therapy in fungous infections has not been successful. In fact, the induction of active or passive immunity in these conditions has not yet been well demonstrated, and so, of course, there is at present no possible vaccination against these more dangerous fungi.

Cooke studied the immune reactions in a human case of coccidioidal granuloma and reported precipitins which gave positive reactions up to 1 to 160 dilutions of the serum against the culture extracts. The serum showed no reaction with culture extracts of blastomyces. Positive skin reactions or complement fixation were not obtained with the Cooke (26) extracts.

It is true, however, that biologic analogies between the fungi and bacteria have been demonstrated in the agglutinin, opsonin, precipitin, and toxin phenomena. Roger and others have isolated a soluble toxin from the *Monilia albicans*. An ether soluble toxin has also been isolated from *Actinomyces bovis* and it is reputed to produce by injection the same lesions as the fungus. Various toxins have been isolated from species of aspergillus.

Specific agglutinins and immune bodies have been reported by vaccinating animals with cultures of saccharomyces, *Monilia candidans* and *M. balcanica*.

De Beurmann reports a skin toxin reaction in patients having sporotrichosis.

Trichophyton vaccines have been made by Bloch. General reaction followed the injection of these vaccines into trichophytosis patients but clinical improvement was doubtful.

The spore-agglutination test for fungi was introduced by Widal but has proven to be of no great value. It is based on the hypothesis that the blood of patients with fungoid diseases contains specific agglutinins for those diseases. In certain instances this has been proven by the microscopic and macroscopic agglutination tests, but as a general diagnostic procedure the results have been not entirely parallel and were often conflicting. It has not been generally accepted, therefore.

All of the various bacterial and serum biologic reactions have been reported for certain fungi by various workers, but the subject still remains in the realm of the problematic, chiefly because of the failure in practical therapy to accomplish the induction of active or passive immunity. With failures in practical immunity there can not but remain the present shadows of doubt as to the true nature of the reported immune body reactions or as to the accuracy of the observations.

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## CLINICAL NOTES

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### INFLUENZAL PNEUMONIA—A CLINICAL REPORT, WITH SPECIAL REFERENCE TO DIAGNOSIS

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During the winter and spring of 1927, influenza, with its accompanying broncho-pneumonia, was present among the personnel of the Hampton Roads Naval Operating Base in epidemic form. It is believed to have been the result of the importation of the infection by the destroyers *Reuben James* and *Lawrence*, which were forced to put in at Hampton Roads on January 8 because of influenza on board. During their stay in quarantine 52 cases of influenza were admitted to the Norfolk Naval Hospital from these ships.

January 13 may be said to mark the beginning of the epidemic, for prior to this date the admission rate for influenza and allied upper respiratory infections from the naval operating base did not exceed the expectancy for this period. From this date on, however, the admission rate rapidly rose. In 10 days 30 to 50 cases were being admitted daily. From January 13 to May 5, when the epidemic was practically over, a total of 1,408 cases was received from the naval operating base, and 65 from other sources, such as ships in port, the Norfolk Navy Yard, and an occasional Veterans' Bureau patient.

During the course of the epidemic a total of 124 cases of pneumonia was admitted to the pneumonia ward. Of these patients 15 died, a mortality of 12 per cent.

The discussion in this paper is based on 95 selected cases, the selection being made wholly on the adequacy of the records kept for such discussion. Some of the records, especially those of cases coming to the ward early in the epidemic, contain only cursory references to the actual physical signs present. Other cases arrived on the ward practically at the beginning of convalescence or after pleural effusions had developed; and as it is the purpose of this discussion to deal rather intimately with the physical findings upon which influenzal pneumonia may be diagnosed and the signs by which certain complications may be recognized, the records of such cases are of no value here. The cases whose records were not used in this discussion were considered only for the purpose of making up a total upon which the mortality rate is based.

## GENERAL CONSIDERATIONS

Upon admission to the ward, routine physical examinations, with special reference to the chest conditions were made, the findings recorded, and a bedside X-ray plate of the chest taken and, whenever the occasion seemed to indicate it, the X-ray examination was repeated. In this way a valuable opportunity was afforded, through constant comparison with the röntgenogram, to interpret and evaluate physical signs.

All the cases of pneumonia coming to the ward during the epidemic were broncho-pneumonia. The pathology varied from a diffuse, spotty infiltration of both lungs, made out only by X-ray examination, to complete consolidation of one or more lobes, in a few instances practically an entire lung. All, however, showed a diffuse clouding. Consolidation was most frequently found in the lower lobes.

In the great majority of cases the diagnosis could be made without the aid of the X ray, though in a small number of cases, it was the only means by which it could be definitely stated that pneumonia existed. In 37 per cent of the cases, typical signs of consolidation; namely, dullness, bronchial breath sounds, bronchophony and pectoriloquy, were found over areas varying in size from that of a silver dollar to an entire lobe. It is to be emphasized, however, that in 29 per cent of the cases the physical findings over areas which showed on X-ray plates as definitely consolidated areas, were not those given as the classical signs of consolidation. Taken in the aggregate, the signs resemble, with certain notable exceptions, those of fluid (2). It was only by the correlation of the findings upon physical and X-ray examinations that the true interpretation of these signs was reached. This is not to say that any original discovery has been made whereby consolidation may be recognized, for there are several references to it in the literature (1), (2), (3).

These findings consist of impairment of resonance and suppression of breath sounds. The note upon percussion may vary from a very slight impairment of the normal resonance to absolute dullness. Upon auscultation there may be anything from a slight suppression of the normal vesicular murmur to practically the total absence of all sound. In such cases rales are generally not present. As an illustration of the definite character of these signs it may be stated that in two cases, on such findings, thoracentesis was resorted to and a dry tap made.

## COURSE OF THE DISEASE

*Onset.*—As a general rule the onset of the pneumonia was gradual, being secondary to the upper respiratory infection which characterized the cases in this epidemic. Its development was marked by no

very pronounced change in the patient's general condition, but its presence was suspected and generally found when there was no improvement in a given case after 24 to 48 hours in bed.

*Pulse and respiratory rates.*—In the majority of cases when pneumonia could be very definitely diagnosed both by physical examination and by the X ray, the pulse rate was found to be surprisingly slow in view of the high temperature and toxemia present. On this basis the cases could be arbitrarily divided into two groups. First, those in which the pulse rate was disproportionately slow in comparison with the height of the fever and the severity of the toxemia present and, secondly, those in which the pulse rate was accelerated in proportion to the temperature and toxemia.

In the former group approximately 70 per cent of the cases fall. The average T. P. R. ratio, as calculated for these 62 cases was T.-103.1, P.-94, R.-25. The individual records in some of the more outstanding cases in this group may be cited:

	T.	P.	R.		T.	P.	R.
Walsh.....	105	85	25	Barnette.....	103	105	30
Roy.....	105.5	110	35	Watson.....	104.5	90	32
McClelland.....	104.1	95	24	Corbitt.....	104	84	22
Blaine.....	105	110	30	Golightly.....	105	110	25

<sup>1</sup> Fatal.

These records are from the early stage of the disease. In those cases which were uncomplicated and which progressed to a favorable termination this temperature-pulse ratio was usually but little altered. In the more serious cases and those in which complications developed, or whose termination was in death, the pulse and respiratory rate became markedly accelerated. Without exception, death was due to cardiac failure.

In the second group approximately 30 per cent of the cases are found. The mean T. P. R. ratio at the onset, as calculated for 24 such cases, was found to be T.-104, P.-124, R.-35.

In comparing these two groups with respect to the ultimate outcome of the individual case, it was found that of 14 cases subsequently developing pleural effusion the one outstanding, and next to meningitis, the most serious complication, 6 of them fall in the former group (10 per cent of the group), 8 in the latter (31 per cent of the group). Of the 15 fatal cases 8 are found in the former (12 per cent of the group) and 7 in the latter (27 per cent of the group). Hence, it is seen that while the pulse rate early in the disease is of no value in leading one to suspect the presence of pneumonia superimposed upon the primary influenzal infection, it is of value as an index to the relative severity of the process, the subsequent develop-

ment of empyema being only 10 per cent of the former group, as compared with 31 per cent of the latter; 12 per cent of the former terminated fatally, as compared with 27 per cent of the latter.

*Temperature curve.*—Following the initial rise it was the rule that with variations of not more than  $1.5^{\circ}$  to  $2^{\circ}$  during the 24 hours, the temperature remained constantly elevated until its defervescence by lysis began or crisis occurred. As the onset of the fever incident to the pneumonic process was gradual, so, too, in the majority of the uncomplicated cases was its termination. Lysis occurred in 44 uncomplicated cases. Of these 32 were characterized by a relatively slow pulse at the onset, while 9 are found in the group characterized by a markedly accelerated pulse rate at the beginning of the disease. In the former group the average duration of the fever from the time the diagnosis was established until the temperature became normal was 8 days, in the latter 11 days. In 14 uncomplicated cases the disease terminated in crisis. Of these, 11 cases fall in the first group, 3 in the latter.

Here again deductions with regard to seriousness of the process based upon the pulse rate at the beginning of the disease hold true, those cases in which there is an initial high pulse rate running a longer course.

*Thoracic pain.*—Thoracic pain was not at all a constant symptom, though a sense of discomfort or oppression in the substernal region was not infrequently present. The charts record actual pain in 35 cases. In seven of these the pain was referred to the substernal region. In one of these cases there were rales on the right side with impaired resonance at the base; but the röntgenogram revealed no definite consolidation. In a second case physical examination revealed no definite sign of consolidation, but the X ray showed a diffuse clouding of the lung fields. In the five remaining cases consolidation was found by physical and X-ray examination at the bases. In four of these the physical findings were those of impaired resonance and suppressed breath sounds. In one of them there was dullness over the left lower lobe with bronchial breath sounds, yet no pain was complained of at the site of this consolidation. In general, these were the less severe cases. All of them made uneventful recoveries.

In the other 28 cases there was pain, increased by respiration, referred to one side of the chest, over the site of the major involvement of the lung, or anteriorly to the lower chest or upper abdomen, when the consolidation was posterior at the base. In nine of these a pleural friction rub was present over the consolidation at the time the diagnosis was made. These were usually the more severe cases. Seven of the group (25 per cent) subsequently developed pleural



effusions on the corresponding side. Seven cases died, five of them following pleural effusions.

*Expansion of the chest.*—Observation of the respiratory excursion of the chest was found to be of value primarily from the standpoint of diagnosis, secondarily from its bearing on prognosis. It was found to be altered in two ways. In the first place, it may be bilaterally restricted, respiration being chiefly abdominal. Such a condition is indicative of widespread, generalized pneumonia, and is, or becomes, associated with cyanosis, prostration, and marked toxemia. Definite areas of consolidation may not be found. Rather are there numerous moist rales of all types, from the bronchial to the crepitant, scattered over the entire chest. The prognosis is bad. It was observed in three of this series of cases, all of whom died.

In the second place, expansion may be limited on one side. From the standpoint of diagnosis this is important, in that it furnishes the first clue as to the side upon which the chief involvement of the lung or pleura is to be sought. Unilateral restriction of expansion, with corresponding predominating pathology within the chest, was noted in 18 cases of this series. In 16 of these it was the left side of the chest that was so affected. Of these 18 cases, 14 complained of pain on the affected side; but in only 4 was there a definite pleural friction rub present when the sign was discovered. In 7 of the 14 cases with pain on the affected side pleural effusion subsequently developed on this side; and it is to this sequence of events that its importance in prognosis attaches; viz, that in 39 per cent of the cases in which, during the onset of pneumonia, unilateral restriction of expansion of the chest was noted, pleural effusion developed during the course of the disease.

*Percussion.*—In 84 per cent of the cases, at the time pneumonia was demonstrable by X-ray examination, its presence could be detected by a change from the normal resonance over the area involved. It is not meant that actual dullness could be elicited in this proportion of cases, nor is such a finding at all essential. Frequently the most that can be said is that over a given area, usually about the inferior angle of one or both scapulæ, the percussion note, while retaining a fair degree of resonance, is somewhat impaired, though dullness, or actual flatness to the point of causing one to suspect the presence of fluid, may be present. Such areas are most frequently found in the lower lobes, though they may be found at other places. They vary in size from that of a silver dollar to areas corresponding to an entire lobe.

*Auscultation.*—In these cases of influenzal pneumonia, auscultation was found to be the most valuable single diagnostic procedure (1). Considered in association with the accompanying findings

upon percussion, its value is enhanced, though in certain cases it was upon auscultation alone that findings were made that called attention to areas which showed on X-ray plates as definite consolidations. In 28 per cent of the cases, exclusive of those in which pleural effusion was present upon admission, areas were found over which there were bronchial breath sounds with bronchophony and pectoriloquy, the classical auscultatory signs of consolidation. It is to be noted, however, that in 29 per cent of the cases these were not the findings over areas of consolidation; and it is to the signs in these cases that attention is invited.

In Murray Leslie's "Pneumonia," published in 1924, under the discussion of the diagnosis of influenzal pneumonia, the following statement is found: "Auscultation gives the most valuable information. Over large areas there may be feeble, almost inaudible breath sounds; indeed, feebleness of the breath sounds is the rule, and is supposed to be due to the blocking of the bronchi leading to the affected areas, either by the profuse bronchial secretion or by swelling of the mucous membrane." In 29 per cent of the 95 cases, such were the findings upon auscultation over areas which showed as consolidations upon X-ray plates made at the time. Over these areas, depending upon their size and the density of the consolidation, all gradations of suppression of breath sounds were to be found, from a slightly subdued respiratory murmur to practically the total absence of all sound. Usually there is a corresponding and commensurate change in the note elicited upon percussion. This association of findings, viz, impairment of resonance and suppression of breath sounds, is to be stressed as indicative of consolidation in influenzal pneumonia. It is a definite clinical entity, the significance of which is attested by the X ray. In the vast majority of cases it is over the lower lobes that such findings are made. (See X-ray plate No. 1.)

*Cyanosis.*—Cyanosis developed in 10 of this series of cases. Of these, 9 patients died, a mortality of 90 per cent. Usually it was of late development and accompanied a failing circulation.

It is beneath the finger nails that its presence is first detected, the normal pink color becoming dull, and of a grayish hue, while the face, ears, and lips frequently retain their pink, flushed appearance for some while. Gradually, it developed into a dull suffusion upon the face, lips, and ears, but never as marked as beneath the nails. These have been described as "heliotrope cases" (1). In this state the patient may die. In a few, however, shortly before death, as the circulation becomes more and more feeble, the skin loses all suggestion of color, is pale and covered with a cold, clammy sweat, while the nails and lips appear an ashy blue, the so-called "pale cyanosis" (1). It is the immediate precursor of death and lasts, at the most, but a few hours.

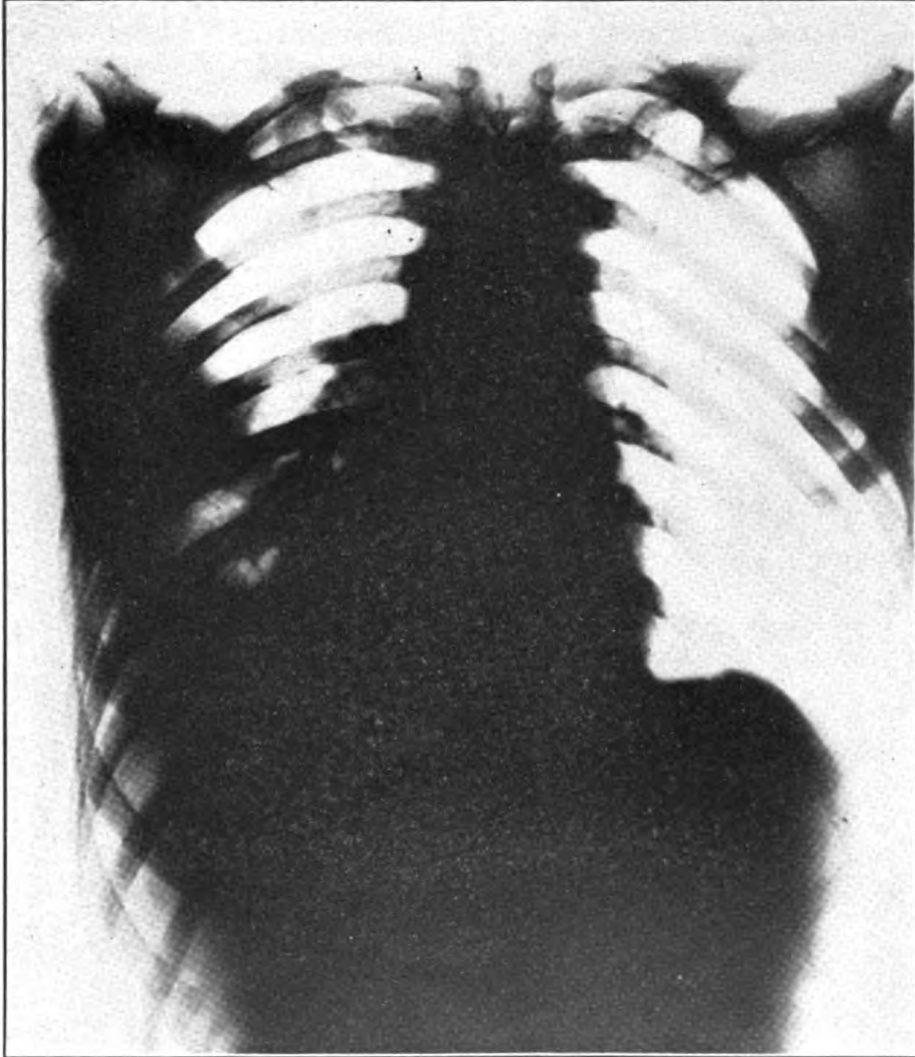


PLATE 1.—TAKEN THE DAY ON WHICH THE DIAGNOSIS OF PNEUMONIA WAS  
MADE

Plate shows dense consolidation in the right lower lobe, with little or no pathology elsewhere. Physical findings over this area at the time the plate was made were those of dullness to flatness with marked suppression of breath sounds.

774-1

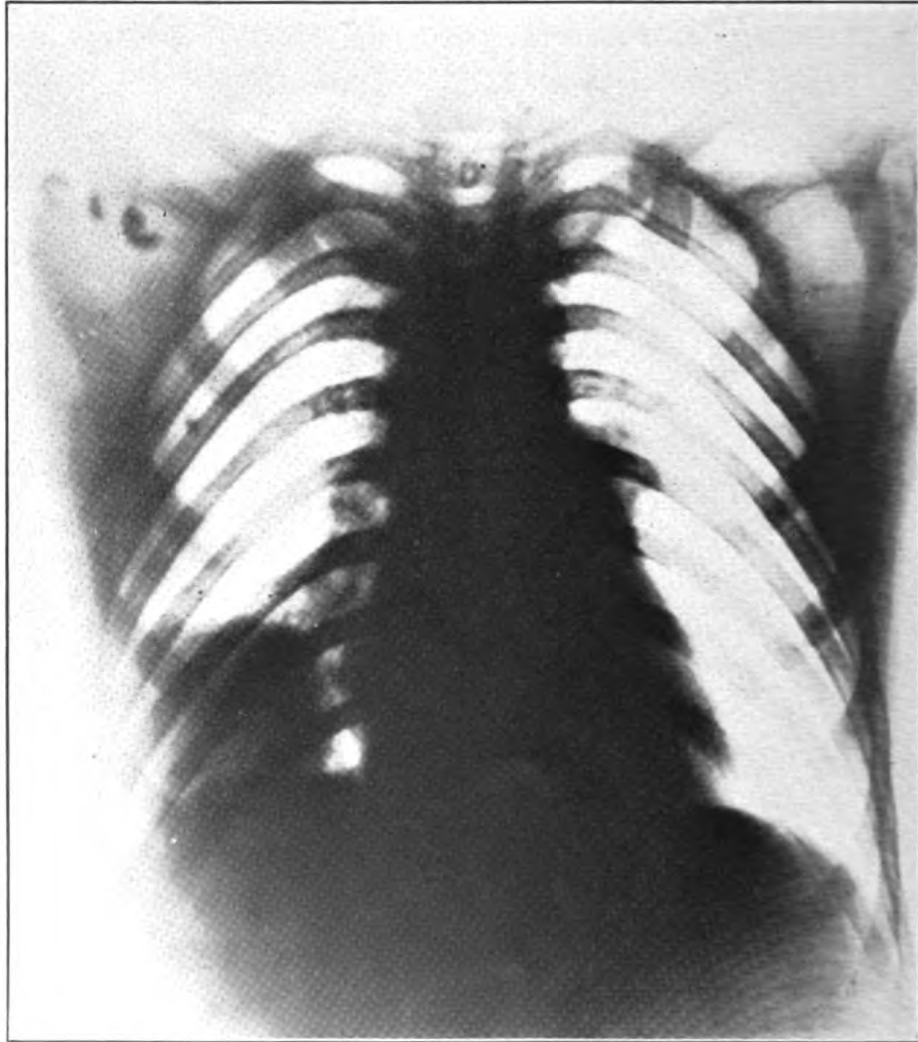


PLATE 2.—SHOWS BRONCHO-PNEUMONIA WITH GREATEST INVOLVEMENT IN THE LEFT LUNG AND A PLEURAL EFFUSION OF MODERATE SIZE ON THIS SIDE

Physical findings at the time the plate was made were those of dullness with general suppression of breath sounds, scattered areas of bronchial breath sounds and fine râles over the left lower lobe.

774—2

*Hemoptysis.*—Far from being a constant occurrence, hemoptysis was relatively infrequent and occurred only in the more serious cases.

*Leukocyte counts.*—As an aid to the differential diagnosis of pneumonia or as a criterion by which one may say that pneumonia has developed in a given case of influenza, white cell counts are of some, though not great, value, for while a definite leukocytosis is of great aid, many cases in the early stages present a normal count. The initial white cell counts following the clinical diagnosis of pneumonia were as follows: 5,000–10,000, 35 per cent of the cases; 10,000–15,000, 24 per cent; 15,000–20,000, 18 per cent; 20,000–25,000, 8 per cent; 25,000–30,000, 2 per cent; and above 30,000, 11 per cent. There appears to be no definite relationship between the white-cell count and the type of pneumonia or character of physical signs present. The physical findings and the accompanying white-cell counts may be tabulated as follows:

	5,000- 10,000	10,000- 15,000	15,000- 20,000	20,000- 25,000	25,000- 30,000	Above 30,000
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Typical signs of consolidation.....	33	31	25	85	50	50
Suppressed breath sounds and impaired resonance.....	43	51	62	15	50	50
Suppressed breath sounds.....	7	9	6	-----	-----	-----
X-ray diagnosis.....	17	9	7	-----	-----	-----

Practically all cases show definite leukocytosis with the full evolution of the disease. An occasional case may show a definite increase in the white cell count with the resolution of the pneumonic process. There was one case of leukopenia, with a relative lymphocytosis, at the onset of the disease. This case was rapidly fatal.

A white cell count above 35,000 should cause one to suspect the development of pleural effusion. In 12 of the 14 cases of effusion in this series, in which white cell counts were done on the day the complication was discovered, the average count was 39,125, with a relative increase in the percentage of polymorpho-nuclear leukocytes.

The highest white cell count in the series, 75,000, accompanied the onset of pleural effusion. This patient died. The minimum white cell count with the beginning of an effusion was 23,750. It must be observed here, however, that certain grave but uncomplicated cases may develop excessive leukocytosis; e. g., one case of 64,000, another 52,000. Both of these patients recovered.

#### ETIOLOGY

Due to the congestion of the laboratory as well as of other departments of the hospital during this period, the personnel and facilities were not adequate for the routine typing of sputum. In those

cases which were typed, the predominating organism was found to be the pneumococcus. In addition to this organism there was present in some sputa, and practically without exception in specimens of fluid from pleural effusions, what was apparently a mutation form of organism between the pneumococcus and the streptococcus, obviously the same organism as that reported by the Army empyema commission from its study of influenzal empyema in the Army camps during the World War; viz, a Gram positive diplococcus, resembling the pneumococcus, some of them forming chains (4). (By this commission the organism is classed as a streptococcus.) A typical laboratory report, even at the first aspiration of a chest, may be quoted as follows: "Stained smear showed numerous pus cells and Gram positive cocci and diplococci having the morphology of pneumococci, some of them forming chains. Cultures showed Gram positive cocci and cocci arranged in chains."

An occasional blood culture was taken on selected cases. All of these were negative, though in one case of meningitis following middle ear disease the same Gram positive chain-forming diplococcus was found in the spinal fluid.

#### COMPLICATIONS AND SEQUELÆ

*Nasal accessory sinuses and aural.*—There were three cases of frontal sinusitis associated with these cases of pneumonia. In two cases which preceded the development of the pneumonia, pleural effusions developed. One mild case occurred as a complication during the course of an otherwise uncomplicated case of pneumonia and did not require other than symptomatic treatment.

There were four cases of otitis media, two of which were transferred to the pneumonia ward after the development of an intercurrent pneumonia. Two of them had been operated upon. One of these subsequently developed a purulent, fatal meningitis, the other, after recovery from pneumonia, remained in the hospital almost a year, during which time a mastoid operation was done for chronic involvement of the mastoid. There was a history of ear trouble in this case in childhood and apparently the attack of influenza lighted up an old infection. The fourth case developed during the course of an attack of pneumonia and cleared normally after paracentesis.

*Mediastinal infections and infection of the soft tissues of the neck.*—These complications were practically absent as compared with their reported frequency in the cases of influenzal pneumonia occurring in the Army camps during the World War. There were no diagnosed cases of mediastinal involvement and but one of infection of the soft tissues of the neck (4). This occurred in the

fourth case of otitis media mentioned above. When convalescence had practically begun the patient began to complain of sore throat and dysphagia. There was a gradual swelling and induration of the submental tissues, lasting several days and subsiding under symptomatic treatment.

*Eyes.*—One case of acute conjunctivitis occurred during the course of one case of pneumonia.

*Heart.*—An occasional, transient, systolic murmur was detected during the course of the disease in some cases and a few cases of functional arrhythmia or "heart consciousness" followed the acute infection. In no case, however, within a period of approximately 12 months following the epidemic, was organic heart disease discovered as a sequel.

*Kidney.*—There were no permanent kidney lesions, though there were numerous cases of febrile albuminuria which cleared up during convalescence. In one case perinephritic abscess preceded the development of pneumonia.

*Respiratory system.*—Empyema is discussed under a separate heading. It was the one serious, outstanding complication, frequently occurring surprisingly early in the course of the disease, in some cases as a terminal event, and, where recovery followed, always leading to a protracted convalescence.

In one otherwise uncomplicated case of rather mild pneumonia there was excruciating pain referred to the lower left chest posteriorly, and requiring the repeated administration of morphine. The physical findings were chiefly those of impaired resonance and suppressed breath sounds over the left lower lobe. No pleural friction rub was detected. The symptoms are ascribed to a diaphragmatic pleurisy.

A residual bronchitis characterized by rales at the bases and indefinite chest pains was not an uncommon sequel. In a few cases, rales were detected chiefly at the apices posteriorly, findings suggestive of tuberculosis. In but two cases, however, was the tubercle bacillus found, one in a case of serous effusion, and the other, a case of pneumothorax. It is questionable as to whether these cases had pneumonia to begin with. the relationship is obscure; and for this reason neither case is included in these statistics.

*Abdominal.*—Tympanites commonly developed in varying degrees of severity in the more toxic cases. Intractable vomiting, some with hematemesis, occurred shortly before death in a few fatal cases, necessitating the giving of fluid intravenously. In no case did recovery follow when it became necessary to resort to this method of administering fluids.

*Nervous system.*—One case of purulent meningitis following middle ear disease was fatal.

There was one case of flaccid peroneal palsy, with typical foot drop, the history of which indicated that the nerve involvement preceded by several days the onset of influenza to which the pneumonia was secondary. This patient was discharged from the service because of the disability.

Delirium of a very active type accompanied two cases of apical pneumonia. It was not marked in the other cases, except in the very serious, toxic ones, in which it was of the suppressed, muttering type accompanying a semicomatose state. One patient, while in the hospital several months later, complaining of indefinite chest pains with little or no physical basis for them, developed symptoms of dementia præcox.

#### PLEURAL EFFUSION

There were 14 cases in which this complication developed. It was the complication of most rapid development and, with the exception of meningitis, the one attended by the most serious consequences. (The mortality of the pleural effusion cases was 36 per cent.) As there was but one case of meningitis, pleural effusion may be considered the one great, serious complication.

As the onset of the pneumonia in influenzal pneumonia and the physical signs accompanying consolidation in this disease are frequently not those observed in lobar pneumonia, so too, in respect to the development of empyema, is there a considerable difference between the two diseases, for whereas in lobar pneumonia the development of empyema is usually gradual and to be expected late, its occurrence being as much a sequel as a complication, there is in influenzal pneumonia a marked tendency to early involvement of the pleural sac, large effusions occurring as early as the first day of the disease. In four cases it developed within the first 24 hours after the diagnosis of pneumonia, the quantity aspirated varying from 370 to 1,225 c. c. The average time of onset in the series was 4.1 days after the diagnosis of pneumonia had been made.

These effusions, if not distinctly purulent to begin with, rapidly become so.

*Diagnosis.*—In the presence of already existent signs similar to those of fluid accompanying uncomplicated consolidations, it may be realized that the early detection of a superimposed pleural effusion is not without its difficulties. There are, however, certain changes in the symptoms present, unless the patient be already in extremis and the effusion occur practically as a terminal event, which should



put the examiner on his guard. These may be summarized as follows:

Pain in the chest.

Orthopnea and "static dyspnea."

Further acceleration of the pulse rate.

Restlessness and further prostration.

The relation of pain in the chest to the development of pleural effusions has already been dealt with. In 50 per cent of the cases it preceded the onset of the effusion. In an early case of influenzal pneumonia which is being seen for the first time, a history of pain in either side of the chest which has disappeared or is at the time becoming less intense, is, therefore, of great significance. Pain referred to either side of the chest or upper abdomen is not the rule in uncomplicated cases of influenzal pneumonia and when it does occur, it strongly suggests an impending effusion. With the onset of the effusion, the pain tends to become less severe.

In rapidly forming, massive effusions, orthopnea may be severe. In more slowly forming effusions, before the exudate into the pleural sac is large enough to cause orthopnea, a form of dyspnea, best described as "static dyspnea," is frequently present. This is to say that when the patient is turned on the opposite side, with the effusion uppermost, great respiratory distress ensues, though he may lie flat on his back in comparative comfort.

The charts show a moderate acceleration in the pulse rate in most cases with the onset of this complication. The change in the respiratory rate is, however, generally more marked.

Restlessness is frequently present. Sweating may be pronounced, especially in cases of relatively long standing which for one reason or another have not been diagnosed. Such cases may go into a state of collapse repeatedly, while the temperature curve follows the typical "pump handle" course of sepsis.

*Physical diagnosis.*—Careful inspection of the chest preceding or in the early stages of the formation of an effusion, will frequently reveal definite limitation of expansion of the chest on the affected side. This sign was present in 39 per cent of the cases in this series.

Fortunately, even in the most desperate cases, there are definite changes in the physical findings upon percussion and auscultation when this complication occurs. These changes in findings are rather a change in the distribution of the areas over which abnormal findings are already manifest than a change in the character of the findings. In order to detect these, daily or even more frequent examination of the chest is essential, and should be done by one who is already thoroughly familiar with the particular case.

In those cases in which consolidation, practically without exception at the bases posteriorly, is accompanied by dullness, tubular

breath sounds, and bronchophony, the detection of a superimposed effusion naturally is not difficult. The percussion note changes from dullness to flatness, the breath sounds becoming distant, though they may retain their tubular quality. Pleural friction rubs disappear with its onset and pain becomes less marked. At the time these changes are first detected, there may be cardiac displacement to the opposite side.

It was said earlier in this paper that, taken in the aggregate, the signs over consolidated areas resemble, with certain notable exceptions, those of fluid. The first of these exceptions is the distribution of the signs or the shape of the areas over which they are manifest. Consolidated areas are frequently circumscribed, and usually found within the lower lobes near the angles of the scapulae. Fluid, especially in the early stages, is not circumscribed. Further, in handling these cases, it should be accepted as an axiom that consolidation does not occur in the axilla or beneath the clavicle. (In the entire series of 124 cases there were but three exceptions to this rule.) Therefore, given a case in which pneumonia is known to exist, when impairment of resonance or dullness with suppression of breath sounds occurs in the axilla or beneath the clavicle, extending upward from the base posteriorly, the presence of fluid is to be disproved only by repeated thoracentesis. Frequently an exudate of sufficient quantity to reach an axilla with the patient prone will develop in 12 to 15 hours. (See X-ray plate 2.) In 8 of the 14 cases of effusion, the initial diagnosis of fluid was made on this finding.

The second exception to the similarity between the findings incident to consolidation and fluid is that of cardiac displacement in the latter, which gives rise to another axiom; viz, that cardiac dilatation does not occur in influenzal pneumonia. Conversely, any displacement of the apex beat to the left or abnormal pulsation in the left second and third interspaces, or to the right of the sternum, is due to cardiac displacement only, this displacement being due to the presence of fluid in the pleural sac. In 37 per cent of the cases this sign was present upon the initial diagnosis of fluid. In one case, early in the epidemic, before the importance of this finding was fully appreciated, fluid was undiagnosed until after death.

It is ever to be borne in mind that massive effusions may take place over night; for this reason the percussion note in the axilla and beneath the clavicle and the position of the heart are to be checked daily in suspected cases.

These two signs, dullness extending into the axilla and beneath the clavicle from the bases posteriorly and abnormal pulsation to either side of the sternum, occurring separately are almost surely

due to the presence of fluid in the pleural sac. Where they are found associated, it is to be looked upon as pathognomonic. One unsuccessful attempt at aspiration does not disprove the presence of fluid. Repeated thoracentesis may be necessary and should always be done when failure is the result of the first attempt.

Litten's sign was looked for, only to be found absent in most cases. In one case, immediately before the aspiration of 1,225 c. c. of fluid from the right chest, whispered pectoriloquy was present both anteriorly and posteriorly over practically the entire right side of the chest, though there was dullness beneath the clavicle and the heart was displaced.

Referred upper abdominal pain with rigidity on the side of the effusion developed in 6 of the 14 cases. The relative infrequency with which this was noted in uncomplicated cases, as compared with its occurrence in 43 per cent of the cases of effusion, makes it a finding of significance.

A white cell count of 35,000 or above, especially with a relative increase of polymorpho-nuclear leukocytes, is further strongly suggestive of fluid.

#### SUMMARY AND CONCLUSIONS

1. The foregoing discussion is based upon 95 selected records from a series of 124 cases of influenzal pneumonia.

2. Influenzal pneumonia is a broncho-pneumonia. In the vast majority of cases its occurrence is secondary to the upper respiratory infection of influenza, though in the presence of an epidemic of influenza an occasional case will be found which begins as a primary condition. The entire symptom-complex and the physical signs upon which the diagnosis is to be made may, and in a high percentage of cases do, differ markedly from those found in ordinary lobar pneumonia.

3. The disease is usually of insidious onset; and its termination is generally by lysis.

4. At the onset the pulse rate is apt to be disproportionately slow in comparison with the fever and the degree of toxemia present. The pulse is, therefore, of little value in leading one to suspect the presence of developing pneumonia in a given case of influenza. It is of more prognostic significance than diagnostic value.

5. Thoracic pain is not a constant accompaniment of influenzal pneumonia. It may be expected in about 30 per cent of the cases. Such pain may be either substernal or unilateral. The latter site of reference is of far more significance than the former. In such cases, the incidence of subsequent pleural effusion on the corresponding side is high (25 per cent of this series).

6. Alteration of the respiratory excursion of the chest is to be expected in about 25 per cent of the cases. It may be found either bilaterally or unilaterally restricted. In the former group, the prognosis as to life is extremely grave (100 per cent fatal in this series), in the latter the advent of effusion on the corresponding side is to be expected.

7. The diagnosis of pneumonia can not be dependent upon the presence of typical signs of consolidation. In a very large group of cases, the findings over areas which show on X-ray plates as definite consolidations, usually in the lower lobes, are atypical. They resemble the textbook picture of fluid, rather than those of consolidation. Impairment of resonance and suppression of breath sounds is characteristic of consolidation in influenzal pneumonia.

8. Cyanosis is, fortunately, of infrequent occurrence. Its development is of grave import. Ninety per cent of the cases in this series in which it developed were fatalities.

9. Many cases of influenzal pneumonia, in the early stages of the disease, present a normal leukocyte count. Practically all cases show definite leukocytosis with the full evolution of the disease. A leukocyte count of or above 35,000 should suggest the probability of pleural effusion.

10. Hemoptysis is to be expected only in the more serious cases.

11. From a study of the available data in the records of this series, no very definite conclusion can be reached as to the nature of the causative organism further than to state that some form of pneumococcus was present, and also a mutation form of organism between the pneumococcus and streptococcus (probably streptococcus) which was responsible for the development of plural effusion in 15 per cent of the cases of this series.

12. Complications and sequellæ, other than empyema, are of minor consideration. In a few individual cases, however, the disastrous results which followed would seem to be a very strong argument against the performance, where in any way avoidable, of operations upon the throat and ear, in the presence of an epidemic of this character.

13. Empyema, or its precursor, pleural effusion, is a complication of influenzal pneumonia, rather than a sequel of the disease. Its onset is to be expected early, though it may be a terminal event. Unilateral pain, with restriction of the respiratory excursion of the chest on the corresponding side are frequent antecedents of the complication. The physical signs incident to its development will, in many cases, be masked by the findings already present due to pre-existing consolidation of lung tissue. Dullness in the axilla and beneath the clavicle extending upward from the base posteriorly, and displacement of the heart are the most reliable physical signs

of its presence. Repeated thoracentesis, where failure is the result of the first attempt to demonstrate its presence, is indicated in all suspected cases. The onset of empyema is usually early (always during the active presence of pneumonia), its development rapid, its occurrence of grave prognosis. Its early detection is essential to the welfare of the patient.

The writer is indebted to Capt. R. C. Holcomb, Medical Corps, United States Navy, commanding officer, and Commander R. F. Jones, Medical Corps, United States Navy, former chief of the medical service, Norfolk Naval Hospital, for permission to make use of the material appearing in this report; and to Lieut. Commander W. H. Whitmore, Medical Corps, United States Navy, for the preparation of the X-ray illustrations.

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#### A CASE OF COMPRESSION OF THE MEDULLA AND UPPER SEGMENT OF THE SPINAL CORD BY OSTEITIS OF THE ATLAS AND AXIS

By H. F. LAWRENCE, Commander, Medical Corps, United States Navy

The patient, aged 66, was admitted to the United States naval hospital, San Diego, Calif., on February 1, 1930.

Chief complaint: Weakness of legs; can not walk.

Family history: Irrelevant.

Past history: Appendectomy, 15 years ago. Past history as obtained has no bearing on later illness.

Present illness: Four years ago the patient had an apoplectic stroke. The stroke came at night while he was asleep. The next morning he tried to get up but could not walk. He had complete motor paralysis of the left leg and thigh but had only partial motor paralysis of the left arm, forearm, and hand. Eight months after the stroke he was able to walk with the aid of a cane. His disability remained stationary until two weeks before his entrance to this hospital, when his left leg became weak and he could not walk. He stated that nine months before admission to this hospital he had two Wassermann tests taken, one being 2 plus and the other, 1 plus.

Examination made on admission: Elderly, fairly well developed and nourished man; can not stand or walk.

**Eyes:** Arcus senilis, both eyes. Both pupils are small. They react slowly to light and accommodation. Both nerve heads somewhat reddened. No definite pathology. No contraindication to salvarsan.

**Ears:** Hearing, 8/15 each ear.

**Mouth:** Complete upper and lower plates.

**Heart:** Enlarged to left. Apex beat visible in fifth interspace, midway between mid-clavicular and anterior axillary line; no murmurs heard. Electrocardiogram, negative. Röntgenogram, 7 foot. Heart moderately enlarged. Arch considerably widened. Probably fusiform aneurysm. Dimensions: M. L., 10 c. m.; M. R., 5 c. m.; M. T. D., 29 c. m.; arch, 8 c. m. Blood pressure, 170/80, both arms; pulse regular, rate 76.

**Abdomen:** Large, protruding; no masses; no pain.

**Extremities:** Weakness of lower extremities; more marked on left side; can not walk.

**Blood:** Kahn test, 2 plus.

**Urine:** Light trace of albumin on eight examinations.

**Spinal fluid:** Kahn test, 4 plus, 36 cells per c. m. m. Pandy's test, positive.

**Reflexes:** Left knee jerk slightly hyperactive. Right knee jerk normal. Babinski absent. No pathological reflexes.

**Mental examination, made after a period of observation:** Alert. In touch with environment and current topics of day, showing interest and comprehension. Regularly read his newspaper. Frequently wrote letters to his friends and relatives. Normal intelligence; good judgment; no delusions or hallucinations or other indications of psychosis.

**Course of disease:** He remained in bed most of the time but occasionally was wheeled about the ward and to the physiotherapy department. For several weeks he could go to the bath room by aiding himself in holding on the beds. His temperature, pulse, and respiration remained normal throughout. Between the dates of February 22, 1930, and April 21, 1930, he received eight doses of tryparsamide intravenously and eight doses of potassum bismuth tartrate intramuscularly. During the last week in March, he began to complain of pain and stiffness of his neck. During the latter part of April, he held his neck almost rigid. He did permit it to be moved slightly and would call out at night for the attendant to change the position of his head. On the day before his death, his right upper and lower extremities showed spastic paralysis. The muscles of mastication, deglutition, the eye and facial muscles, were not affected. During the evening of April 30, 1930, it was noticed that his abdomen was distended. He died May 1, 1930.

The autopsy, as reported by Lieut. Commander W. W. Hall, Medical Corps, United States Navy, is as follows:

F. S., who died at 12.35 a. m., May 1, 1930. Diagnosis, hemiplegia. The body, which had been embalmed, was that of a well-developed, well-nourished male of about 70 years apparent age.

*Chest.*—No increase of pleural fluid.

*Lungs.*—The apex of the left lung was bound down by firm adhesions. Both lungs showed marked anthracosis. The upper lobe, left lung, was firm and fibrous. Numerous small, healed tubercles were scattered throughout the fibrous tissue. Practically no functional tissue left in this lobe.

*Heart.*—Small amount of bloody fluid present in the pericardial sac, probably due to the post-mortem heart puncture for blood culture. The wall of the left ventricle was thin (2 mm.). The left ventricle appeared normal in thickness and color. The mitral valve leaflets showed some thickening of the margins. The aortic valve appeared normal. There was a moderate degree of sclerosis in the aorta adjacent to the ring and around the coronary orifices. Coronary arteries showed some thickened spots. From the first part of the aortic arch downward and throughout the thoracic aorta, there were most extensive atherosclerotic changes. In a number of places the areas of atheromatous softening in the media had broken through the intima, and small thrombi were forming on the margins of the ulcerated area. There was a fusiform aneurysmal dilatation of the aorta in the descending portion of the arch, the sac bulging more posteriorly and to the left, tending to sacculation in that direction.

*Abdomen.*—Peritoneal fluid was clear straw-colored and somewhat increased in amount.

*Liver.*—Normal in size. Capsule smooth and glistening. On section the markings showed evidence of a slight degree of chronic passive congestion.

*Kidneys.*—Appeared congested; cortex thinned; markings distinct.

*Spleen.*—Increased in size (350 gm.) and soft. Capsule somewhat thickened. Pulp extremely soft and hemorrhagic.

*Adrenals.*—Normal.

*Pancreas.*—Normal.

*Brain.*—The convolutions of the whole cerebrum appeared shrunken. There was an excess of cerebrospinal fluid. The convolutions at the superior portion of the right precentral area were softened, stained brown, and a considerable amount of the gray matter of several convolutions was lost. The superior left precentral convolutions also showed similar staining and evidence of old damage, but the loss of substance was very slight. There was no further abnormality noted in the cerebrum, cerebellum, pons, or medulla. After the brain was removed, a bony process, about three-fourths of a centimeter in diameter, was noted projecting upward in the posterior side of the foramen magnum. The cut end of the medulla was anterior to this bony projection. While manipulating it, the tip was broken off. It was honeycombed and soft. The atlas and epistropheus were dissected out and the process was found to be the dens or odontoid process of the epistropheus which had sagged backward in the foramen magnum, forcing the medulla to one side. A rarefying osteitis had caused a partial absorption of the whole right side of the atlas. The facet which articulated with the occipital condyle was very small, and the anterior and posterior limbs of the arch on the right were about half the size of that on the left. The transverse process and the transverse foramen for the passage of the vertebral artery were not present. On the inferior aspect, the

right articular facet and the corresponding facet of the epistropheus were gone. The right transverse process of the epistropheus had crumbled and the ring of the atlas had sagged forward on the right side. The third cervical vertebra was somewhat involved in the process with rarefaction and some loss of substance on the right side, and lipping and bony union with the epistropheus around the margin of the articular facets on the left. When the soft parts were digested away from the bone with sodium hydroxide solution, the areas of bone most involved by the rarefying process crumbled.

#### SUMMARY AND COMMENT

1. A rarefying osteitis was found, involving the first, second, and third cervical vertebrae with partial absorption of the right side of the first and second, and dislocation of the atlas forward and to the right.

2. Protrusion of the odontoid process of the epistropheus into the foramen magnum, was noted, with dislocation of the medulla to the right and anteriorly. The protrusion of the odontoid into the foramen had probably taken place gradually as absorption and settling on the right side had gone on. Dislocation of the medulla laterally must have taken place as this occurred, for the medulla is closely applied to the foramen as it passes through. The dislocation of the odontoid posteriorly, and the forcing of the medulla laterally and anteriorly as far as it was found at autopsy, may have occurred partially at the time of death, and possibly completed during the post-mortem handling of the body.

#### PATHOLOGICAL DIAGNOSIS

1. Rarefying osteitis of the first, second, and third cervical vertebrae, with compression and settling of the vertebrae on the right.

2. Protrusion of the odontoid process of the epistropheus into the foramen magnum, as a result of the settling of the vertebrae.

3. Compression of the medulla by the odontoid.

4. Softening and loss of substance (apparently from old hemorrhage) of the superior precentral convolutions on the right side, and a similar change, but much less in extent, in the same area on the left.

5. Diffuse atherosclerosis of the aortic arch and thoracic aorta.

6. Fusiform aneurysm of the descending portion of the aortic arch.

7. Old healed tuberculosis of the upper lobe, left lung.

8. Chronic passive congestion of liver.

9. Congestion and softening of the spleen.

#### COMMENT

The probable cause of the osteitis of the cervical vertebrae was syphilis. The paralysis of the left side was of four years' duration.



The paralysis on the right side was of one day's duration. The lesions of the brain, both right and left, were old. The probable cause of the paralysis developing during the last 24 hours was pressure on the cord in its upper segment. This pressure on the cord, and possibly also the medulla, was the direct cause of death.

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### MEDICAL SURVEYS

#### A DISCUSSION FROM THE VIEWPOINT OF THE RECRUITING EXAMINER

By G. F. COOPER, Lieutenant, Medical Corps, United States Navy

One of the most discouraging features in recruiting is the medical survey of recruits sent to training stations. In cold print, as tabulated in monthly statistical reports, surveys for poor vision, color blindness, enuresis, constitutional psychopathic state, albuminuria, venereal disease, etc., seem like carelessness on the part of the medical examiner at the recruiting station. No doubt, in many instances, such is the case, but there are several factors which are beyond the control of the recruiting examiner.

The above-mentioned factors must come under one of three headings, and the responsibility of accepting, and later losing, the recruit comes under the same three headings. These are as follows:

1. Recruiting personnel.
2. The recruit.
3. Training station personnel.

#### RECRUITING STATION PERSONNEL

- (a) Types of canvassers.
- (b) Medical examiner.
- (c) Conduct of examinations.
- (d) Applicant's impression of Navy gained at recruiting station.

#### THE RECRUIT

- (a) Desire to enlist.
- (b) Homesickness.
- (c) Malingering.
- (d) Ability to perform duty regardless of defect.

#### TRAINING STATION PERSONNEL

- (a) Care and treatment of recruits.
- (b) Instruction in malingering.
- (c) Medical and Hospital Corps personnel.
- (d) Environment of recruit.

## 1. RECRUITING STATION

(a) *Canvassers*.—None should be ordered to recruiting duty without careful consideration of his habits, morals, desire for recruiting, and training in recruiting methods. This is done at present, but occasionally misfits arrive for duty at recruiting stations. One instance is known in which a canvasser was very profane, and persisted in swearing very loudly and often in his ordinary conversation, and in the presence of recruits. On one occasion, a recruit became very much dissatisfied and stated that he did not want to go to the training station because he thought that he might receive duty under some one of the type of the canvasser mentioned. Needless to say, the canvasser's bad habit was corrected when known to the officer in charge, but the fact remains that the canvasser should not have been ordered to recruiting duty.

(b) *Medical examiner* should be sympathetic and able to understand the feelings of young applicants when they leave home, many of them for the first time. A little gruffness on the part of the examiner will cause many more tachycardias than usual. An assurance to the individual that he is all right will often cause a fast heart to drop to normal inside the 3-minute interval.

(c) *Conduct of examination*.—Everything pertaining to the examination should be systematized, and absolute quiet and orderliness observed during the examination. A "hard-boiled" Hospital Corps man assisting in the examination can make applicants very miserable, if he is inclined to and is allowed to do so by the medical officer. On the other hand, the proper conduct by all concerned can send away a happy, laughing group of boys looking forward to their first big adventure.

(d) *Applicants' impressions*.—All of the above and the impressiveness of administering the oath and the idea of businesslike management, imparted by all hands, in the conduct of recruiting, will give the applicant a feeling of respect for the Navy—glad to be a member of such an organization.

## 2. THE RECRUIT

(a) *Desire to enlist*.—Most boys make application to the Navy only after many months of thought on the subject, and if it meets their expectations, they are satisfied to remain in. If, however, they are rebuffed or rebuked unnecessarily and have some slight defect which may keep them out, if disabling, they are more inclined to lay stress on the pain from depressed arches, or to exaggerate dimness of vision or defective hearing.

(b) *Homesickness* is another very important complaint and very natural in the age-group of average recruits. Considerate care and

an effort to keep up morale by athletics and amusements does much to overcome the complaint.

(c) *Malingering*.—There seems to be some one at every training station who is ready to instruct recruits in the art of malingering, and it is believed that more careful examination by medical officers and fewer "snap-shot" diagnoses would save the Government much money in transportation costs. In the case of an applicant with previous Army service, who has hiked miles with flat feet, and who signs a statement that his feet have never given him trouble, it is believed that he should be given an opportunity to do duty and not sent back home after 8 or 9 days at a training station because his feet appear flat.

In the case of an enlarged inguinal ring, when there is slight or no impulse, the probability is that the boy has had the condition most of his life. If it does not bother him, it would seem well to give him a chance to demonstrate his ability to carry on. Especially is this so if he consents to operation, should it become necessary at a future date.

### 3. THE TRAINING STATION

(a) *Instruction in malingering*.—In one instance, a boy who had been previously discharged for being under age, and a little keener than the average recruit, was surveyed for osteomyelitis of one toe. When going into the examining room, he stubbed his toe (applicant's own statement). The Hospital Corps man noticed a scar on the applicant's toe, gave the toe a jerk and asked him if it hurt. The applicant replied that he had just stubbed it and that it would hurt anyone's toe to have it pulled in such a manner. However, he was surveyed after nine days' service. He desires to reenlist and the bureau has now authorized him to be reexamined and a waiver submitted. If he is accepted again, it seems that much money will be spent needlessly, due to careless examination at the training station.

(b) *Environment of recruit*.—This, of course, includes his associates. If he joins with some of the renegade types occasionally seen, he may desert, or return home with a B. C. D., or feign disability and obtain a medical survey.

In considering certain conditions for which recruits are surveyed, the following remarks are deemed pertinent:

Vision: Could not be poor if found 20/20 at the recruiting station.

Color blindness: Same as above.

Albuminuria: Many temporary albuminurias will disappear in 24 hours or less.

Flat feet: If symptoms are present, they should be found at the recruiting station, but if the individual has never had symptoms,

there should be no necessity for surveying him during his first few days of training.

**Constitutional psychopathic state and allied disorders:** These may not be noted by an examiner untrained in mental disorders, and may pass unnoticed by an expert at times.

**Varicocele:** If large, or with symptoms, should be rejected at recruiting station.

**Venereal diseases:** Can be detected, if present, at time of examination. However, if the man is exposed three days prior to examination and develops disease en route to training station and denies exposure when examined it should not be charged to the recruiting examiner.

**Shortness of breath on exertion** is a condition that can be feigned with ease, and the applicant who desires survey will answer "yes" when asked if he is short-winded after exercise.

**Eneuresis:** Applicant may deny the fact that he is a "bed wetter" when examined. However, it would be easy to wet the bed every night even though called every hour, if applicant was informed that "bed wetters" are surveyed.

**Hernia:** The statements made under "Conduct" of examination in regard to relaxed inguinal rings are pertinent. However, it is easy for an applicant to cough gently enough to give only a slight impulse or none.

The seven most common causes of rejection of applicants by medical officers are as follows:

1. Defective teeth.
2. Errors of refraction.
3. Flat feet.
4. Underweight.
5. Deformities.
6. Ear affections.
7. Heart affections.

The first four should be easily detected and the applicants rejected at the recruiting station.

Deformities, if not very noticeable, are a question of judgment, and into this enters the personal equation. The recruiting examiner at the training station may decide that the condition is such as to warrant survey from the service.

Defective hearing and diseased conditions of auditory canal and membrane should be detected at the recruiting station.

Heart affections come under the same status as deformities, but for all general purposes it is best that the recruiting examiner reject any applicant with a heart condition if he is not certain of the diagnosis. In this as in all other cases, the Government should have the benefit of doubt.

## CONCLUSIONS

1. Medical surveys are necessary in the service as a means of eliminating the unfit, but may be used by able individuals to separate themselves from the service.

2. Careless examinations or too hasty conclusions may be the cause of increased cost in transportation and other expenses by eliminating individuals who desire to remain in service but have some defect which does not interfere with function.

3. Men with slight defects could, in many instances, be allowed to demonstrate their ability to perform duty before being surveyed.



# RESERVE CORPS

## APPOINTMENTS JULY 9, 1930

Name	Rank	Class	Appointed
Caulfield, Philip A.....	Lieutenant (junior grade).....	MC-V (G).....	Mar. 13, 1930
Drees, Lawlor A.....	Lieutenant (junior grade).....	MC-V (G).....	Mar. 5, 1930
Harris, Herman L.....	Lieutenant (junior grade).....	MC-V (G).....	Mar. 24, 1930
Hemsath, Frederick A.....	Lieutenant (junior grade).....	MC-V (G).....	Mar. 29, 1930
Hofer, Clarence J. M.....	Lieutenant (junior grade).....	MC-V (G).....	May 29, 1930
Johnson, George S.....	Lieutenant.....	MC-V (S).....	Mar. 3, 1930
Lineberry, Ellis D.....	Lieutenant (junior grade).....	MC-V (G).....	May 29, 1930
Mankin, Gilbert H.....	Lieutenant commander.....	MC-V (G).....	Mar. 28, 1930
McKeen, Harold R.....	Lieutenant commander.....	MC-V (S).....	Mar. 19, 1930
Sharp, Ezra A.....	Lieutenant (junior grade).....	MC-V (G).....	Mar. 8, 1930

## PROMOTIONS

Name	From—	To—
Boles, Albert.....	Lieutenant, MC-F.....	Lieutenant commander, MC-F.
Cox, Russell M.....	Lieutenant (junior grade), MC-V (G).....	Lieutenant, MC-V (G).
Falconer, Fay H.....	Lieutenant (junior grade), MC-V (G).....	Lieutenant, MC-V (G).
Gaston, Ira E.....	Lieutenant, MC-V (S).....	Lieutenant commander MC-V (S).
Hitzemann, Louis A.....	Lieutenant (junior grade), MC-V (G).....	Lieutenant MC-V (G).
Hutchinson, Charles J.....	Lieutenant, MC-F.....	Lieutenant commander, MC-F.
Kennedy, Thomas J.....	Lieutenant, MC-F.....	Lieutenant commander, MC-F.
Lane, Charles W.....	Lieutenant, MC-V (G).....	Lieutenant commander MC-V (G).
Marsden, George A.....	Lieutenant (junior grade), MC-F.....	Lieutenant, MC-F.
McGranahan, James H.....	Lieutenant (junior grade), MC-V (G).....	Lieutenant, MC-V (G)
Phillips, John R.....	Lieutenant (junior grade), MC-V (G).....	Lieutenant, MC-V (G).
Sheley, Melson W.....	Lieutenant, MC-V (G).....	Lieut. commander, MC-V (G).
Short, John T.....	Lieutenant, MC-V (G).....	Lieut. commander, MC-V (G).
Slominski, Harry H.....	Lieutenant, MC-F.....	Lieut. commander, MC-F.
Toland, John H.....	Lieutenant, MC-V (G).....	Lieut. commander, MC-V (G).

## TRANSFERS

Name	From—	To—
Arnold, Herman B.....	Lieutenant (junior grade), MC-V (G).....	Lieutenant (junior grade), MC-F.
Kler, Joseph H.....	Lieutenant (junior grade), MC-V (G).....	Lieutenant (junior grade), MC-F.
Mullins, Roy L.....	Lieutenant (junior grade), MC-V (G).....	Lieutenant (junior grade), MC-F.
Saverien, Arnold.....	Lieut. Commander, MC-V (G).....	Lieut. Commander, MC-F.





## NOTES AND COMMENTS

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### EPIDEMIOLOGY AND PATHOLOGY OF YAWS

Basing their report on a study of 1,423 consecutive cases of yaws seen during the peregrinations of a traveling clinic in Haiti, Dr. P. W. Wilson, United States Navy, and Dr. M. S. Mathis, United States Navy, have contributed a paper (in the April 26, 1930, number of the Journal of the American Medical Association) which presents some distinct advances in our knowledge of the epidemiology and pathology of yaws.

They found that yaws is, in a large percentage of cases, a disease of childhood; 61.9 per cent of the cases reported occurred in children under 10 years of age, and 19.2 per cent in the second decade. Breaks in the skin are the usual port of entry of infection, as evidenced by the predominance of the lower extremities as the site of the mother yaw. Practically, peasants go barefoot most of the time. There is a certain predilection of the moist, exposed surfaces to primary infection. The genitals of Haitian country children are as much exposed as the lips. Yaws becomes less prevalent the higher the altitude above 2,500 feet. This may be due to the more abundant insect carriers at the lower level.

The writers believe that (in Haiti) "the insect which is the most frequent transmitter of yaws at the lower altitudes is a small gnat (*Hippelates flavipes* Loew) seen hovering in swarms around all open lesions and moist surfaces that may be present on man or beast, and often present in such numbers as to obscure completely the outline of the lesion. These insects were not seen at 4,000 feet and rarely at 3,000 feet, but from 2,500 feet down to sea level they become increasingly abundant."

The mother yaw leaves a scar which usually persists throughout the life of the individual. It is believed that yaws is occasionally the cause of aortitis, aneurysm, and of cerebral hemorrhage in young adults. Though not proved, the authors believe that yaws is occasionally hereditary. Mucous buccal and pharyngeal patches yielding a spirochete have been found in 3.7 per cent of cases of secondary yaws eruption. All patients with "saber shins" gave a history of yaws in early childhood. There appears to be a regional limitation

of tertiary yaws lesions in approximately 11.1 per cent of cases. All patients having the mother yaw on one leg had the tertiary lesion on the same leg. The secondary period fails to occur in about 1.4 per cent of cases. The time interval between the appearance of the primary lesion and the secondary eruption is extremely variable, usually about two to four weeks, but not infrequently this is much prolonged. The secondary eruption is occasionally of the maculopapular type. Yaws may occasionally cause ptosis, blindness, optic neuritis, and perhaps atrophy. Arsenic-resistant cases of yaws occur occasionally. Acetarsonne seems to be the arsenical of choice for general rural clinic treatment of yaws.

From the clinical evidence alone, Wilson and Mathis conclude that yaws in Haiti is epidemic syphilis for which the Haitian peasant has developed a fair degree of tolerance, and that in cases of untreated yaws there is a high degree of immunity to infection by the city strain of spirochete.

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#### DIAGNOSIS AND TREATMENT OF YAWS

Medical officers serving in tropical countries where yaws exists can find no more illuminating information on the subject than that contained in the most recent contribution by Capt. C. S. Butler, Medical Corps, United States Navy. This paper appears as the leading article in the last number of *International Clinics* (Vol. II, Series 40).

Doctor Butler, as usual, writes convincingly and entertainingly on the identity of yaws and syphilis, building up his case on various grounds—historical, pathological, clinical, epidemiological, experimental, serological.

He presents evidence that yaws is congenital just as syphilis is congenital; he explains why the initial lesion is usually extragenital; why the disease is usually contracted during childhood.

He points out that yaws produces the same vascular and visceral lesions that syphilis produces; that yaws *does* occur in temperate climates, that there is no essential difference between the yaws chancre and syphilitic chancre; that there is cross immunity and identical serology in yaws and syphilis.

In certain tropical countries, such as Guam, Samoa, Haiti, “\* \* \* epidemic syphilis (yaws) is decreasing markedly in its incidence. \* \* \* Epidemic is being converted into venereal syphilis” as a result of the treatment brought to the natives of these countries.

The unity concept is the only concept that can wholly explain the epidemiology of yaws.

If we try to explain the epidemiology upon the basis of the yaws virus being distinct, then we hoist an epidemiological monstrosity not duplicated in the whole range of medicine for we have a virus that will infect a black man but not a white one; a virus that confines itself rather rigidly to certain races and to certain geographic latitudes and yet which idiosyncratically may appear in other populations thousands of miles from its endemic home, as in Edinburgh, New York, Berlin, or Quebec. These sporadic yaws cases usually make their appearance "out of the blue" so to speak, with no contact with a similar case. Then, too, how can we explain a contagious disease which will infect a country dweller but not a city one, or which will disappear from a population when there is still pabulum to work on, for there is no natural immunity to *T. pertenue*.

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#### THE EXTENT OF THE PROBLEM OF SYPHILIS AND GONORRHEA IN THE UNITED STATES

"When confronted with any community problem, it is logical for the professions concerned to define its nature and scope. This is a necessary first step in directing control efforts and in measuring their effectiveness."

T. Parran, jr., and L. J. Usilton, of the United States Public Health Service, writing in the April, 1930, number of the American Journal of Syphilis, thus indicate the importance of such a survey, and then present an unusually enlightening article which embraces a reliable estimate of the prevalence of venereal diseases in the United States.

Assuming that the prevalence of venereal diseases is the same in the whole country as in the selected communities surveyed, in which 20,901 physicians and 940 clinics, serving a population of 17,758,000, reported the number of cases of syphilis and gonorrhoea under treatment, these writers estimate that there are 643,000 cases of syphilis and 474,000 cases of gonorrhoea constantly under medical care in the United States. The case rates on which these estimates are based are for gonorrhoea 4.88 for males and 1.78 for females. These case rates for syphilis are 4.77 for males and 3.08 for females.

Approximately 31 per cent of the total cases of venereal disease under treatment are being treated at public expense.

The peak age group for the onset of both gonorrhoea and syphilis was determined as 20 to 25 years.

In the Navy in 1927 the venereal disease annual attack rate was 132.3 per 1,000 of the total personnel, and in the Army the rate was 49.7 per 1,000. Among the second million men drafted dur-

ing the World War, 56.7 per 1,000 were found by casual clinical examination to have a venereal disease.

Here is a disease, syphilis, which is cured only after prolonged and expensive treatment, if at all; which terminates in general paralysis in from 2 to 5 per cent of all cases, and in some instances in spite of the best treatment; which contributes an estimated 8,700 deaths annually in mental institutions from this one complication alone; which is an important factor in deaths from heart disease; which causes a considerable percentage of all fetal deaths; which pads the compensation payments in industry; which more than occasionally is directly responsible for industrial accidents; which contributes 4 per cent of the population of our insane institutions; and which leaves in its wake wrecked homes, blasted hopes, diseased progeny, and a train of other social disasters.

Among the general male population between the ages of 15 and 45 it is estimated that the number of noneffective days lost through venereal diseases would approximate 21,000,000 days per annum.

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#### CRITICAL TREATMENT PROBLEMS IN TO-DAY'S SYPHILOLOGY

John H. Stokes, Philadelphia (Journal A. M. A., April 5, 1930), discusses recent developments in the control of infectiousness by organized and socialized treatment, which is, in essence, the management of early syphilis; the problem of bismuth; the prevention and control of the two most threatening aspects of late syphilis, disease of the heart and of the nervous system; and smoother treatment. He says physicians should encourage and use the university clinic, the medical school and hospital and the public health clinic; take more time to explain to the patient with syphilis what they are about, for an intelligent talk makes for cooperation, confidence, and friendliness, and these are as important as drugs in cure; read and keep up to date, drawing syphilotherapy from the journals and the schools, and not from hearsay and the pharmaceutical detail man; accept and put in practice in the management of early syphilis the fruits of the past decade's best controlled investigations. About the problem of bismuth he says: Select two or three good bismuth preparations and learn to give them without disturbing the patient. Then let the rest go by, for five years, until an authoritative summary appears in the literature. Practically all the work that a bismuth preparation can do for the average man to-day can be done with the fat-suspended potassium bismuth tartrate, the salicylate; or, if one considers European practice, the glucose-suspended hydroxide or metallic bismuth. One who wishes to see what tryparsonide can do, must use it continuously, not in broken courses, in the individual case for not less than two years, before expecting to find the serologic reversal of blood and fluid reactions on which so much stress is laid.

The combination of tryparsamide and of a nonspecific fever induced by typhoid-paratyphoid vaccine, whose possibilities have barely been touched and whose simplicity and accessibility exceeds that of malarial treatment, is a direction in which important advances can take place. He concludes by saying: We can smooth the road of treatment by an irreproachable technic in the use of the agents we have available, and in a thorough application of the known principles governing their action and reaction in the patient. Where do we of the rank and file meet our difficulties in the treatment of the patient with syphilis? 1. We do not examine the patient adequately before we fire the first shot. 2. We too often fail to envisage an aim, a purpose for which we are treating, in part because we have not appraised the case adequately. 3. The practitioner systematically forgets, or has never understood, the Herxheimer reaction, or therapeutic shock. A third of his troubles come from this source. 4. We forget too easily the double-edged effect of rapid healing produced in a syphilitic lesion by an arsphenamine. 5. The therapist too often does not know his drugs and their complications. 6. We overlook too easily the niceties of technic. Hurting the patient in any therapeutic procedure is, in cumulative effect, a serious matter.

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#### INTRAVENOUS UROGRAPHY

Elsewhere in this issue Dr. John Duff discusses the uses, advantages, and limitations of intravenous urography.

Those interested in the subject will find considerable information in the published clinic of Dr. Edwin Beer, Mount Sinai Hospital, which appeared in the June, 1930, number of the Surgical Clinics of North America.

Doctor Beer is of the opinion that intravenous urography is one of the most important contributions to general medicine and to urologic and general surgery that has developed in recent years, and that of the many men who have been attacking the problem, Dr. M. Swick would seem to be the first to solve it in a satisfactory manner.

Beer believes that a great usefulness for Uroselectan exists in cases where there is intolerance of repeated cystoscopic pyelograms and a frequent "checking up" on the kidneys is desired. Also, it is a great help in cases where the ureteral orifice can not be seen or catheterized for pyelography.

He has used it in the diagnosis of functionless kidneys and for the study of the function of transplanted kidneys and ureters.

**MENINGITIS DUE TO TORULA HYSTOLITICA**

Meningitis caused by *Torula hystolytica* is sufficiently rare to warrant the reporting of all cases.

Much confusion has resulted from a failure to simplify the nomenclature of pathogenic fungi, and most of the cases of yeast infections reported in America have been reported as "blastomycosis." In general, the term has been used to designate a disease, systemic or local, caused by a yeastlike organism which reproduces in the tissues by budding.

The condition was first recognized by Gilchrist and was described by him in 1894. Montgomery and Ricketts reported three cases in 1901, and the same year Hyde and Ricketts abstracted 17 cases reported up to that time, adding three of their own.

Bassoe's case, reported in 1906, was the first one in which vertebral involvement was noted.

Within the last 10 years more than 100 articles on the subject have appeared in the literature, and the increasing number of reported cases from widely scattered sections of the country lends credence to the belief that the disease is fairly common, and that increasingly accurate diagnostic methods are responsible for its detection.

Elsewhere in this issue of the *BULLETIN* G. W. Cooper gives a detailed account of the cultural characteristics of these organisms and the diagnostic technic and criteria.

J. E. Miller reported a case with meningeal involvement from the San Diego Naval Hospital in the September, 1925, number of the *BULLETIN*. E. C. White reported a similar case from the same hospital in the July, 1930, number of the *BULLETIN*.

J. C. Massey and J. S. Rooney reported a case of meningitis due to *Torula* in the May 24, 1930, number of the *Journal of the American Medical Association*. In this, as in other reported cases, the symptoms and physical signs were inconclusive. Massey and Rooney state that the differential diagnosis lies between tuberculous and syphilitic meningitis, atypical encephalitis and unlocalized brain tumor. The positive diagnosis is made with the identification of the organism in the spinal fluid or pathologic specimens. In Massey's and Rooney's case, no portal of entry could be demonstrated.

In the June, 1930, number of *Surgery, Gynecology and Obstetrics*, T. Banford Jones reports in considerable detail a yeast infection of the cervical vertebrae, in which the diagnosis was considered tuberculosis until the post-mortem examination revealed the true nature of the condition. In this case the patient had been unable to work for a year because of muscle pains and weakness in the left arm. Examination showed atrophy of the muscles about the thumb and

the intrinsic muscles of the hand, weakness in the left hand and arm, especially of muscles supplied by the sixth and seventh cervical and first thoracic segments through the median nerve and eighth cervical and first thoracic through the ulnar. Sensory changes coinciding with the cutaneous distribution of the sixth, seventh, and eighth cervical and first thoracic were also marked. All motions of the head and neck were painful. X-ray examination showed erosion of the transverse process of the seventh cervical and the articulating facets of the seventh cervical and first thoracic vertebrae on the left. At operation an extra pleural abscess was found, containing about 10 c. c. of pus and running parallel to the second rib.

Wilhelmy, who reported a case with meningeal involvement in 1925 in the American Journal of Medical Sciences, expressed the opinion that the meningeal form differs from the other forms of blastomycosis only in that the meninges are invaded early, with death occurring before systemic involvement takes place.

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#### SIMPLIFIED TREATMENT OF THORACIC EMPYEMA

Dr. A. O. Singleton, writing in the June, 1930, number of the Annals of Surgery, reports on a simplified treatment of thoracic empyema which he used on a series of 81 consecutive cases at the John Sealy Hospital, Galveston, Tex. The mortality for the series was 6.3 per cent.

While rib resection with open drainage has been and still is the favorite method, there is a growing tendency to use some form of closed drainage.

Singleton's technic is as follows: The intercostal nerves in the space drained, and one rib space above and below, are blocked with novocain proximal to the wound. Also 1 to 2 cubic centimeters of alcohol are used to block the intercostal nerve of the space drained in order to avoid pains from pressure of the canula for several weeks.

A trocar with attached canula is inserted one rib space below the angle of the scapula and directly below. The canula remains in place, stitched to the skin. The rubber tube which connects with the canula is filled with water and led to a large bottle beside the bed. The end of this tube is placed under water, thus retaining a vacuum, with a siphon effect. The vacuum is maintained for 8 to 10 days, when leaking of air around the canula occurs. The canula is then replaced by a rubber tube of the same size. The tube should not be left out until the cavity is nearly obliterated.

**MEDICAL SUPERVISION OF COMMERCIAL AIRPLANE PILOT**

Harold J. Cooper, Washington, D. C. (Journal A. M. A., April 26, 1930), points out that flying is more than an ordinary activity. From the medical standpoint it calls for a physical and neurologic make-up in the pilot more exacting than the requirements in other pursuits of life if one is to be successful at it. The medical examination aims to aid in the selection of those showing the maximum in the way of suitability and, what is equally important, it aims to maintain this suitability. The eyes are examined to determine uncorrected visual acuity, ability to judge distance, and ocular muscle balance. The field of vision for form and color is taken with the perimeter, the color vision determined and an ophthalmoscopic examination made. The ears are examined for hearing and signs of middle and internal ear disease. A self-balancing test is performed to determine equilibrium. The condition of the nose, throat, and sinuses is noted. The general examination is very complete and includes a urinalysis. There must be a satisfactory family and personal history, and there must be no disease, defect, or limitation such as would reasonably interfere with proper bodily function. The neurologic examination aims to elicit defects of reflexes, station and gait. The psychomotor tension is observed and measured. Tremors, tics, and sensory or motor disturbances are noted. The applicant is questioned on various phases of his past in an effort to elicit what his reactions and behavior have been to situations of stress so as to throw some light on his probable reactions and behavior under the conditions of stress in flying. At the completion of the examination the examiner gives his impression of the temperamental make-up of the applicant. The following list is illustrative of favorable traits: Emotionally stable, alert, frank, intelligent, trained, cheerful, modest, moderately aggressive, cooperative. Unfavorable traits commonly include one or more of the following: Emotionally unstable, dull, superficial, vague, vain, arrogant, untrained, withholding. The Department of Commerce accepts and rejects its applicants on the basis of its set of physical standards. Listed as disqualifying are factors known by experience to constitute a hazard and a handicap in themselves. When the department denies a license on physical grounds it does not mean that the applicant concerned can not learn to fly, or that, having learned, he is unable to continue flying, but it does mean that such an applicant, if licensed, will be operating under a handicap of more than a reasonable amount. The Department of Commerce depends, in the majority of instances, on the regular medical profession for the carrying out of its medical program. There are nearly 750 physicians throughout the United States and its possessions aiding in this work. All



student, private, and industrial pilots are examined annually. Pilots carrying persons and property for hire are examined semiannually. Since the air commerce act of 1926 became effective, physicians have examined more than 43,000 applicants. Many of these men have, of course, undergone one or more reexaminations, with the result that more than 58,000 reports of medical examinations have been received and reviewed. Cooper reviewed 9,103 cases. He found that 35.4 per cent of all the students with no defects whatever reached a higher (private or commercial) grade of license within 13 months. Of those students who had one or more defects at or close to the minimum requirement level, 18.5 per cent reached a higher grade within the same time. Of those who had slight deviations from the normal but were considerably above the minimum requirements, 30.3 per cent reached a higher grade. So far, information on the matter of age indicates that, when no physical defects are present, those above 30 years do as well as those under 30. This in itself would indicate that 30 years is too young to mark the point beyond which a difference is to be expected. Experience with age 30, however, does indicate that age over 30 plus physical defects is more of a handicap than the same defects in those under 30. A great deal of good, in a health way, has been accomplished in the handling of the border-line case. There have been innumerable cases in which the uncorrected visual acuity has been below minimum requirements and apparently due to the wearing of improper corrections. Following refraction and the wearing of proper lenses, many of these applicants have been able to qualify later. Albumin in the urine has been cleared up following treatment of infected sinuses and teeth and the removal of infected tonsils. Removal of foci of infection has frequently improved the cardiac response to exercise. In numbers of cases chronic otitis media has been cured or so improved as to warrant qualification. The fact that hernia is disqualifying in passenger-carrying pilots has led to the surgical repair of numbers of these defects. Many operators of air lines are at the present time subjecting their pilots to monthly physical examinations designed, obviously, for the purpose of maintaining their health and reliability. The examinations frequently reveal signs of deterioration from fatigue or minor ailment, and, when they do, the pilot is usually relieved of his duties for a period of rest or treatment. In this way it is hoped that the specialist in aviation medicine will soon be able adequately to show the operator that the continued health of his pilot will increase his efficiency and prolong his period of usefulness. While the school operator occasionally complains that physical standards are so exacting that his business is thereby retarded, Cooper is convinced that strictness on matters

of physical fitness has worked for the benefit of the group, even if at times the individual has been denied. The public is entitled to the assurance, in its patronage of air transportation, that not only the plane but also its pilot is airworthy.

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#### SCHILLING'S DIFFERENTIAL COUNT

The total and differential leukocyte count often fail to give the precise information desired, since the total count does not always indicate the patient's resistance, and the percentages of the different types of cells have wide normal variations.

Dr. W. C. Black presents, in the June, 1930, number of *Colorado Medicine*, an excellent résumé of the improvements in differential count work contributed chiefly by Arneth and Schilling.

The Schilling type of differential count gives promise of becoming a dependable diagnostic and prognostic method. The Schilling method records changes in the blood picture which occur before the appearance of or in the absence of physical signs. Essentially, it records the appearance in the circulation of immature neutrophils.

In 1904 Arneth published his classification of polymorphonuclear leukocytes, dividing these cells into five main classes according to the number of segments in the nucleus. Arneth showed that the number of cells in each class, out of 100, varies only within narrow limits in health, but that in the presence of an infection there is a decrease in those of more segments and an increase of those with the fewer segments. This change he called the "shift to the left." The factors producing this reaction are assumed to be an increase of young cells entering the circulation, and an increase in the rate of cell destruction, especially of the older cells. This reaction varies with the severity of the infection and returns to normal with recovery.

Certain technical difficulties interfered with the widespread clinical application of the Arneth method. Schilling's modification is based upon the same principles of cell development and includes not only the adult type cells but their precursors as well. In Schilling's count the leukocytes are classified as follows (the percentages given indicate approximately the normal limits): Basophils, 0.25-1.0 per cent; Eosinophils, 1-4 per cent; myelocytes, none; young metamyelocytes, none; older metamyelocytes or "staff" cells, 0-10 per cent; adult polymorphonuclear neutrophils or segmenters, 60-70 per cent; lymphocytes, 20-30 per cent; monocytes, 1-6 per cent.

"A shift to the left manifests itself as an increase in the percentage of 'staff' cells with the appearance in the circulation of metamyelocytes and possibly myelocytes. Eosinophils disappear, and the lymphocyte percentage becomes reduced. With recovery there

is a progressive drop in the percentage of 'staff' cells, and disappearance of myelocytes or metamyelocytes. The lymphocytes increase to above their normal percentage, and eosinophils reappear in the blood."

For more extensive discussion of the subject, reference may be made to the following: Schilling, V., *The Blood Picture and its Clinical Significance* (see April, 1930, *BULLETIN* for review, p. 437), and Piney, A., *Clinical Atlas of Blood Diseases* (see July, 1930, *BULLETIN* for review, p. 656).

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**THE UNITED STATES AND NICARAGUA COOPERATE IN SANITARY SURVEY  
OF NICARAGUA CANAL ZONE**

Since the arrival of Dr. Jacinto Perez, Director General de Sanidad of Nicaragua, and Capt. J. J. Figueras, Medical Corps, United States Army, at San Carlos, the sanitary survey of the Nicaragua Canal Zone has been progressing satisfactorily. The primary purposes of the survey are to determine the sources of diseases prevalent in the area with special attention to human carriers, prevalence of insects and the breeding places of those known to transmit diseases; the extent to which the present inhabitants of the zone of the canal are infected by these diseases; and the water supply for domestic purposes available in the zone and the incidence of disease conveyed by its present use. This sanitary survey will be of enormous benefit to the present inhabitants of the zone, as it will determine the character of the diseases now prevalent in the area and, where practicable in the field, treatment for the cure of the diseases will be given. The most prevalent diseases have been found to be hook worm; dysentery both amoebic and bacillary; and malaria. Some 750 individuals have been examined in the San Carlos area and specimens have been taken for laboratory study.

In order to facilitate the above work a map of San Carlos was prepared, and census established, individual containers for specimens distributed and cards for tabulated index prepared in accord with the census. Most of the specimens collected were brought to Granada, where they will be studied and diagnosed. The personnel at San Carlos is continuing the hook worm investigation. Upon completion of such work at San Carlos the party will probably move to Greytown where they will follow the same process, working towards Colorado Bar. Upon completing the necessary work at this point the personnel will be transported to Camp Hoover, Ochoa, where they will cover the area to include Castillo. Upon completing the work at Castillo the party will return to San Carlos and will then go to the town of Rivas.



## BOOK NOTICES

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Publishers submitting books for review are requested to address them as follows:

The Editor,

UNITED STATES NAVAL MEDICAL BULLETIN,  
Bureau of Medicine and Surgery, Navy Department,  
Washington, D. C.

(For review.)

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EDWARD JENNER AND THE DISCOVERY OF SMALLPOX VACCINATION, by *Louis H. Roddis, Lieutenant Commander, Medical Corps, United States Navy.* George Banta Publishing Company, Menasha, Wis., 1930. Price, \$1.

Three books in three successive centuries exercised a profound influence on medicine and science. The *De Fabrica Humani Corporis* of Vesalius, published in 1543, furnished the first real knowledge of the structure of the human body. William Harvey's *De Motu Cordis et Sanguinis*, published in 1628, announced the discovery of the circulation of the blood; a discovery which Sir Thomas Browne said he preferred to that of Columbus. In 1798 Edward Jenner's *The Inquiry into the Causes and Effects of the Variolae Vaccinae* described the discovery of smallpox vaccination and established the principle that artificial immunity to disease could be induced by safe and simple procedures. From the demonstration of this principle, the preventive medicine of the nineteenth century takes its departure.

As Jenner's discovery was one of the most epochal and one of the most beneficent contributions in the whole history of medicine, the story of smallpox to Jenner's time, the story of Jenner's discovery and the story of Jenner's life and times are all stories that are absorbing, that are as interesting as they are important to all medical minds, stories that should appeal even to those who have only a casual interest in the history of medicine.

Dr. Roddis has written a neat little book that demonstrates well in its 150 pages the author's surpassing historical sense, his skillful allotment of space proportionate to the historical importance of the topics and to the amount of human interest present, his broad knowledge of his subject and its bibliography, his careful appraisal of

events, his fine precision of English, and lastly, his industry as a collector of historical material.

Chapter I deals with the history of smallpox to Jenner's time, and includes some mention of the great epidemics of the early historical times and of the victims of smallpox—several monarchs and other notables.

Chapter II is an account of the practice known as skin inoculation or variolation. It includes several letters written by Lady Montagu, who was an ardent proponent of the practice, having introduced it in England after observing its effects in Constantinople.

Chapter III includes Benjamin Franklin's "Some Account of the Success of Inoculation for the Smallpox in England and America," which he sent to William Heberden in 1759; and William Heberden's "Plain Instructions for Inoculation in the Smallpox."

Chapters IV and V comprise an excellent biography of Jenner; Chapter VI narrates his discovery of vaccination. Chapter VII tells of the spread of the practice of vaccination following Jenner's discovery. Chapter IX concerns the last years of Jenner's life and an estimate of his work.

The illustrations are excellent, are well chosen, and add measurably to the value of the book.

*HISTORY OF HAITIAN MEDICINE*, by *Robert P. Parsons, Lieutenant Commander, Medical Corps, U. S. Navy*. Foreword by *Edward R. Stitt, Rear Admiral, Medical Corps, U. S. Navy*. Paul B. Hoeber, New York, 1930. Price, \$2.25.

The following review appeared in *The Military Surgeon*, September, 1930:

It is a natural assumption that the writer on medical history and biography is qualified for his task by knowledge and interest in both medicine and history. To these more usual qualifications of the medical historian, Doctor Parsons possesses others that peculiarly fit him to be the annalist of Haitian medicine. In the first place, he is familiar with the language, literature, history, and culture of France, attainments that make him the better able to appreciate and appraise the conditions of society in this former French colony. In the second place, he was not a transient visitor to the island who came there for a few weeks in search of local color, but having served in Haiti as a medical officer attached to the Public Health Service he had lived and worked among its people for a sufficient time to obtain more than a few superficial impressions of the country. Furthermore, he has a broad and tolerant viewpoint which has given him a sympathetic understanding of the problems of the Haitian people that is often wanting in the observer from another race and nationality. This sympathetic appreciation is seen in the account of the work of Dr. Leon Audain; the renaissance of a scientific spirit in medical circles in Haiti from 1890 to 1910; the founding of an important medical journal, *La Lanterne Medicale*; and the upbuilding of the National Medical School. It is also seen in the descriptions of colonial medicine; the views of slavery in colonial days; and the slave diseases, yaws, malaria, and

yellow fever. Not the least interesting are the brief but illuminating biographical sketches of the great negro leaders of the revolt and early years of independence, Toussaint Louverture, Dessalines, Christophe, and Boyer.

The naval medical officer will be particularly attracted to those chapters in which the work of the Medical Corps is described in the building up of the Public Health Service of Haiti; the stamping out of contagious and infectious diseases; furnishing medical treatment to the rural population; instituting sanitary improvements throughout the island; furthering medical education, as well as carrying out extensive research in tropical medicine. Whatever criticism may be made of American intervention in Haiti it must be said that the work there of the Medical Corps constitutes achievements that have brought only benefit to the Haitian people and credit to the Navy and the United States.

The foreword by Admiral Stitt, who as a writer of international reputation on tropical medicine and as Surgeon General of the Navy during an important part of the occupation period, speaks with special authority, contains a brief survey of the splendid work accomplished by medical officers of the United States Navy, not only in Haiti but in the Virgin Islands, Samoa, Guam, and the Philippines, and urges a better recognition of its value.

There are 21 fine illustrations and a small but excellent folding map of Haiti.

The book is attractively printed and bound as may be expected of a Hoeber imprint.

**HANDBOOK OF THE HOSPITAL CORPS, UNITED STATES NAVY, 1930.** Published by the Bureau of Navigation under the authority of The Secretary of the Navy. Government Printing Office, Washington, D. C., 1930. Price, \$1.40.

All personnel of the Medical Department will welcome the appearance of this long-needed new edition of the Handbook. It is a very distinct improvement over the previous edition and should prove of great value as a reference work for corpsmen, as a teaching agency for medical officers, and as a source of authoritative information needed by corpsmen in the training which fits them for their duties and for advancement to higher ratings.

**SURGICAL DIAGNOSIS, by American Authors.** Edited by *Evarts Ambrose Graham, A. B., M. D., Biaby Professor of Surgery, School of Medicine, Washington University, St. Louis; Surgeon in Chief to Barnes and Children's Hospitals and to Washington University Dispensary, St. Louis.* Volume 3. W. B. Saunders Co., Philadelphia, 1930.

The third volume of this excellent work on Surgical Diagnosis is now at hand and it maintains in every way the high standard set by volumes 1 and 2.

In this volume Doctor Graham has written the chapters on "Surgical Diseases of the Thorax" and "Diseases of the Liver and

Biliary Passages." When one of Doctor Graham's ability writes on his pet subjects there is little left to be written on those subjects.

Among the other outstanding authors contributing to this volume are Dr. Dean Lewis, who has written the chapter on "Peripheral Nerves," Dr. Walter E. Dandy on "Skull, Brain, and its Membranes," Dr. Isaac Y. Olch on "The Diagnosis of Diseases of the Breast," and Dr. Frank Hinman on "The Clinical Diagnosis of Diseases of the Genito-Urinary Organs." There are also several other chapters which pick up the odds and ends of surgical conditions.

In reviewing this work one is impressed with the newness of it. Everything is brought up to date so that when one finishes a subject he feels that he has just read the last word. The work is exceptionally well illustrated and is presented in such a manner that reading is a decided pleasure.

For those that are interested in making correct preoperative diagnoses this work will be an invaluable aid.

**MINOR SURGERY**, by *Arthur E. Hertzler, M. D., Chief Surgeon, Halstead Hospital, and Victor E. Chesky, M. D., Chief Resident Surgeon, Halstead Hospital.* Second Edition. C. V. Mosby Company, St. Louis, 1930. Price, \$10.

This edition remains essentially the same as the previous one with additions and corrections of the text and the addition of 37 illustrations.

There is a wide difference of opinion as to what should be regarded as minor surgery. The chief stress in this book has been placed upon the recognition of lesions while they are yet minor.

No attempt has been made to include methods not in use in the Halstead Hospital.

As in the previous edition the pathology of disease is not discussed, since the object of this book is wholly to aid the dispensary student to understand what he sees in his daily work and to enable him to gain a general perspective of the subject which may be only partly illuminated by his clinical observations.

**A SYNOPSIS OF SURGERY**, by *Ernest W. Hey Groves, M. S., M. D., B. Sc. (Lond.), F. R. C. S. (Eng.), Surgeon to the Bristol General Hospital; Professor of Surgery, Bristol University; etc.* Ninth Edition. William Wood and Company. New York, 1930. Price, \$5.

This has the appearance of a quiz compend for use by students about to undergo examination. In fact, the author states in his preface to the first edition that "it has been compiled almost entirely from notes made by the author in preparing students for examination."

The fact that the book has reached its ninth edition bespeaks its value as a memory aid in retaining a large array of facts in an orderly manner.



THE DRAMATIC IN SURGERY, by *Gordon, Gordon-Taylor, O. B. E., M. A., F. R. C.S., Surgeon to Middlesex Hospital.* William Wood and Company, New York, 1930. Price, \$4.

This little book is just what it purports to be, the substance of a lecture delivered by the author in 1928. It will make interesting reading to the surgeon whose horizon takes in more than the humdrum of everyday surgery.

A SHORTER SURGERY, by *R. J. McNeill Love, M. B., M. S., London F. R. C. S. Eng.* Second Edition. William Wood and Company, New York, 1930. Price, \$5.

The second edition of this book is essentially the same as the first, reviewed in the July–October, 1929, number of the BULLETIN. It is a good surgery compend and nothing more.

CLINICAL FEATURES OF HEART DISEASE, by *Leroy Crummer, M. D., Emeritus Professor of Medicine, University of Nebraska.* Second Edition. Paul B. Hoeber, Inc., New York, 1930. Price \$4.

However valuable medical texts may be as reference works, it is not often that we find one that may be called readable—readable in the sense that one can become absorbed in it and continue reading it, chapter after chapter and hour after hour, as one would read a brilliant literary production. When a medical book does appear that is readable in this way, it is so refreshing to the jaded minds of those who must go in for extensive reading of medical literature that they feel very much indebted to the author; they feel that they can find no sufficient words of praise for his book.

Oliver Wendell Holmes was a medical writer of just that sort of appeal; so was Weir Mitchell, and Sir James Mackenzie. There were others, too, but not many. They “put across” their points in a delightful style that charmed and held the readers; that made them read their works for the sake of good reading as well as for the information contained in the pages.

Doctor Crummer’s book on heart disease entitles him to a permanent place among the immortals who have contributed refreshing medical books.

Crummer is a disciple of Mackenzie, whose work did so much to change the attitude of the profession from Skodiac’s idea of anatomical diagnosis to the more rational standpoint of analysis of the functional power of heart muscle. The book imparts an understanding of the newer cardiac physiology, which enables one to recognize and interpret most cardiac irregularities by his own unaided senses.

Facing the first page of each chapter is a quotation from earlier works, classics in the literature on the heart, some of them of quite early dates. Each of these quotations expresses the essence of the chapter for which it is selected. Doctor Crummer’s choice of these

quotations reflects his wide distinction as a medical historian. Among the authors from whose works he has selected passages, may be mentioned: Sansom, Leopold Auenbrugger, Laënnec, Mackenzie, Broadbent, and William Harvey. But the most apt quotation comes from Kipling's *Kim*, and prefaces what impresses this reviewer as the finest chapter in the book—that on inspection.

Kipling showed in his story of the development of Kim's powers of perception the degree of perfection that may be attained; Conan Doyle, appreciating the amount of information that could be brought forth by one who could observe and interpret in the manner of his teacher, Dr. Joseph Bell, built up his famous character, Sherlock Holmes, the master of interpretative inspection. Just so, Doctor Crummer, realizing that "in the art of diagnosis, nothing is more important than inspection, and yet, in the general teaching of the student, no part of his training is more neglected," and that "conclusions properly drawn by unaided vision may be as precise and accurate as though the eyes were aided by a set of lenses or a fluoroscopic screen," sets down in this chapter, a brilliant discourse on the items of information that may be gathered on a heart case by careful inspection of the patient.

Emanuel Libman, who wrote the introduction, gives an estimate of the book which will be shared by many readers. He remarks:

For many years we have been in need of books of just this character, in all branches of clinical medicine. \* \* \* It teaches how much can be learned about patients by simple methods of physical examination \* \* \*. I found it so interesting, profitable, and enjoyable that I kept on reading until I had finished it at one session and had marked numerous passages for re-reading.

*PHYSICAL DIAGNOSIS*, by *Richard C. Cabot, M. D., Professor of Clinical Medicine in Harvard University; formerly Chief of the West Medical Service at the Massachusetts General Hospital.* Tenth Edition. William Wood & Co., New York, 1930. Price, \$5.

It is not surprising to note that this book has now reached its tenth edition since its original appearance in 1905.

Those familiar with the book will understand its sustained popularity and its high ranking among books on the subject of physical diagnosis. One has only to peruse the pages to perceive that if Richard Cabot is a gifted clinician he is even more gifted as a writer and teacher.

The more important new matter introduced in this edition relates to coronary disease, electrocardiography, cancer of the lung, "cardiac asthma," toxic hepatitis, and encephalitis lethargica.

The sections on laboratory methods have been revised and brought up to date.

**MANUAL OF PHYSICAL AND CLINICAL DIAGNOSIS**, by *Dr. Otto Seifert, late professor of Medicine, Wurzburg, and Dr. Friedrich Mueller, Professor of medicine, 11 Med. Clinic, Munich*, authorized translation from the twenty-fourth German edition by *E. Cowles Andrus, M. D., Associate in Medicine, Johns Hopkins University*. J. B. Lippincott Co., Philadelphia, 1930.

As stated in the preface of this little book, the authors have attempted to give in small space the essentials of physical and clinical diagnosis. In this they have succeeded very well and have produced a work that is of value to the interne and to the practicing physician for ready reference in the office or at the bedside. That it has reached its twenty-fourth edition in Germany attests its popularity in that country. The colored plates are excellent.

**MANUAL OF THE DISEASES OF THE EYE**, by *Charles H. May, M. D., Director and Visiting Surgeon, Eye Service, Bellevue Hospital, New York, 1916 to 1926; etc.* Thirteenth Edition. William Wood and Company, New York, 1930. Price, \$4.

May's compact and very valuable little book on Diseases of the Eye has been on the Navy Standard List for many years and is well known to naval medical officers.

The twelfth edition appeared in August, 1927. This new (thirteenth) edition is some 20 pages longer than the previous edition, but is still of handy size. It replaces the twelfth edition on the Supply Table.

In this edition whole chapters have been rewritten; many alterations and a few new illustrations have been incorporated.

These changes have resulted in a distinct improvement over the older editions.

**DISEASES OF THE NOSE, THROAT AND EAR, MEDICAL AND SURGICAL**, by *William Lincoln Ballenger, M. D., F. A. C. S., Late Professor of Otology, Rhinology, and Laryngology, College of Medicine, University of Illinois, Chicago; etc.* Revised by *Howard Charles Ballenger, M. D., F. A. C. S., Associate of the Otho S. A. Sprague Memorial Institute Laboratory of the Children's Memorial Hospital, Chicago; etc.* Sixth Edition. Lea and Febiger, Philadelphia, 1930. Price, \$11.

This book has had a place on the Navy Standard List for so many years, and its superior standing as an authoritative work of immense value has been so widely recognized throughout the profession, that little need be said here beyond announcing the appearance of a new (sixth) edition.

The chapters devoted to the Sinuses, Suppurative Otitis Media, and Mastoiditis have been largely rewritten.

A notable addition to the section on the Larynx has been made by Drs. G. Tucker and C. L. Jackson who have contributed the part on Bronchoscopy, Laryngoscopy, Esophagoscopy, and Gastroscopy.

The chapters on the Physiology and Functional Tests of the Labyrinth and the Indications for Labyrinth Operations have been rewritten by Dr. Alfred Lewy, who has also revised the chapter on Inflammatory Diseases of the Labyrinth.

**A MANUAL OF DISEASES OF THE NOSE AND THROAT**, by *Cornelius G. Coakley, A. M., M. D., F. A. C. S., Professor of Laryngology and Otology in the College of Physicians and Surgeons, Columbia University, etc.* Seventh edition. Lea and Febiger, Philadelphia, 1930. Price, \$4.50.

This is a compact and handy little manual which should meet the needs of students and practitioners. That it has been well received by the profession is shown in the fact that it has now reached its seventh edition.

The author has adhered to established facts and has avoided controversial subjects and detailed description of the minutiae of various operative procedures.

**AFFECTIONS OF THE EYE IN GENERAL PRACTICE**, by *R. Lindsay Rea, B. Sc., M. D., M. Ch., F. R. C. S., Surgeon to Western Ophthalmic Hospital; Ophthalmic Surgeon to West End Hospital for Nervous Diseases; Ophthalmic Surgeon to London Lock Hospitals, etc.* Lea and Febiger, Philadelphia, 1930. Price, \$3.50.

This book is dedicated to the general practitioner, is meant for him, and should be found valuable by him.

It is a handy little book of 150 pages, containing some excellent illustrations and much helpful information that the physician needs in dealing with the eye conditions he encounters in general practice.

**THE CHEST**, by *L. R. Sante, M. D., F. A. C. P.* Volume Eleven of a Series of Monographic Atlases of Röntgenology, edited by *James T. Case, M. D.* Paul B. Hoeber, New York, 1930. Price, \$20

This splendidly printed and illustrated book is the eleventh volume in a series of monographic atlases designed to illustrate in detail the various fields in which the X ray is an important assistant in diagnosis. This most recent addition to the series deals with one of the parts of the body in which the internist and the surgeon most frequently seek for additional light on their cases. The book is divided into three main parts:

1. Gives general consideration to X-ray technique, and interpretation, and to the anatomy and physiology of the chest.
2. The evidence of disease as seen in the röntgenogram are grouped as to location and described in detail.
3. Each disease is considered from its beginning to its termination in a series of röntgenograms that show the progress of the pathological condition.

The commonly met diseases of the chest, as tuberculosis, pneumonia, and pleural effusion are given particular prominence. Injuries of the chest are also dealt with at length.

On the whole, the book forms a most comprehensive reference work and one that should be available to every röntgenologist.

**ULTRA-VIOLET RAYS IN THE TREATMENT AND CURE OF DISEASE**, by *Percy Hall, M. R. C. S. (Eng.) L. R. C. P. (Lond.), Hon. Actino-Therapist, The Mount Vernon Hospital, London and Northwood; Hon. consulting physician to the Hull Municipal Light Clinic, etc.* Fourth edition. C. V. Mosby Co., St. Louis, 1930.

In the introduction, by Leonard Hill, we are reminded of the now established power of ultra-violet rays in increasing the defensive mechanism of the body and in the cure of certain diseases, such as rickets and surgical tuberculosis. Professor Hill also presents a short discussion on the mechanism by which ultra-violet radiation produces its salutary effects.

This is an extremely valuable little book which well carries out its mission of presenting to the profession both the uses and indications of ultra-violet radiation, and the technical matters concerned in its application.

Two new chapters have been added in this edition; one dealing with the question of lamps for self-administration, and the other with the question of dosage.

**PHYSIOLOGY AND BIOCHEMISTRY IN MODERN MEDICINE**, by *J. J. R. Macleod, M. B., LL. D., D. Sc., F. R. S., Regius Professor of Physiology in the University of Aberdeen, Scotland; formerly professor in the Western Reserve University, Cleveland, Ohio.* Sixth edition. C. V. Mosby Co., St. Louis, 1930. Price, \$11.

This is a book of more than a thousand pages which supplies a vast field of information on the principles of physiology and biochemistry with particular reference to the application of these subjects in the practice of medicine.

It amounts to an advanced text in physiology and biochemistry, and will bring much satisfaction to those in search of an understanding of the physiological and biochemical principles involved in disease.

Of very special merit is the part on metabolism, a 200-page section including 20 chapters. This section in itself would provide a splendid book and a liberal education in metabolism and nutrition.

**THE BEGINNINGS: EGYPT AND ASSYRIA**, by *Warren R. Dawson, F. R. S. E., Fellow of the Royal Society of Medicine, of the Society of Antiquaries of Scotland, and of the Royal Anthropological Institute of Great Britain and Ireland.* Paul B. Hoeber, New York, 1930. Price, \$1.50.

This is the first of a series of small volumes dealing with the history of medicine.

The history of medicine is a romance which was born by man's "striving after the preservation of youthful vigor." In this struggle "man has made an endless series of compromises with fate

to prolong his active existence by means of magic, by the use of amulets, and as a later development of these concepts, by medicine. Man has ever sought to repair by art the damage done to him by nature."

From the first chapter, which relates many of man's primitive superstitions surrounding the eternally debated mystery of death, we are led into the development and workings of the magician in Egypt and his evolution in to the physician. The relationship of the peculiar religious superstitions concerning burial and embalming to the advance of medicine and the furtherance of our research is emphasized. We find Assyrian medical history to be just a smaller and less precocious twin sister of Egyptian medical history.

The book presents a splendid view of the dawn of the history of medicine.

*MEDICINE IN THE BRITISH ISLES*, by *Sir D'Arcy Power, K. B. E., F. R. C. S., Eng., Honorary Librarian at the Royal College of Surgeons of England; Consulting Surgeon, St. Bartholomew's Hospital, London.* Paul B. Hoeber, New York, 1930. Price, \$1.50.

This comprises Volume II of the *Clio Medica Series* which was inaugurated by Dawson's "The Beginnings: Egypt and Assyria," and which is edited by E. B. Krumbhaar, the widely known medical historian.

D'Arcy Powers' story is a concise history of the intricate development of medicine in the British Isles.

"The history of medicine in this country is mainly a history of its corporate bodies," for by the stimulation of incorporated interest medicine developed by high ethical standards into a supreme science. The British Isles have produced a great number of scientific men who have driven the piles for the prodigious structure called medical science.

On reading this little book one should discover a multitude of interesting facts, and also come to appreciate more fully the magnanimity of these scientists who engage in a life-taking struggle for the preservation of the lives of others.

*INFANT NUTRITION*, by *Williams McKim Marriott, B. S., M. D., Professor of Pediatrics, Washington University School of Medicine; Physician in Chief, St. Louis Children's Hospital, St. Louis.* C. V. Mosby Company, St. Louis, 1930. Price, \$5.50.

The recent advances in our knowledge of nutrition have been so extensive and so rapid that there is now ample justification for the frequent appearance of new books on any phase of the subject.

Much of the former confusion and controversy concerning the nutritional requirements of infants need no longer prevail, and the profession may greet cordially any book, such as this one, that summarizes the facts of our present-day knowledge of infant feeding.

“\* \* \* The simpler means are especially stressed in this book, as any complication of methods is not only unnecessary but introduces greater chances for error. \* \* \*”

“Throughout the book an effort has been made to stress the importance of the chemical pathology of the body as related to feeding and nutrition, as an understanding of this enables one to apply much more intelligently therapeutic procedures. This phase of the subject receives especial consideration in the chapters on Anhydremia, Acidosis, and Alkalosis, Rickets, and Tetany.”

**TUBERCULOSIS IN PUBLIC SCHOOL CHILDREN**, from the *Henry Phipps Institute of the University of Pennsylvania* under a grant from the *Metropolitan Life Insurance Company*. Reprinted from the *American Review of Tuberculosis*, Volume XX, No. 4, October, 1929.

This book will be of particular value and interest to those whose practice includes pediatrics and to those especially interested in tuberculosis.

Numerous short case histories, diagrams and X-ray illustrations have been well used to increase the reader's understanding of the text.

There are four sections, all contributed by recognized authors:

Tuberculosis in Public School Children, by Eugene L. Opie, H. R. M. Landis, F. Maurice McPhedran, and H. W. Hetherington.

A Survey to Determine the Prevalence of Tuberculous Infection in School Children, by H. W. Hetherington, F. Maurice McPhedran, H. R. M. Landis, and Eugene L. Opie.

Open-air Schools for the Treatment of Tuberculous Children, by H. W. Hetherington.

The Diagnosis and Classification of Pulmonary Tuberculosis in Childhood and Adolescence, by F. Maurice McPhedran.

**A TEXT BOOK OF PHARMACOGNOSY**, by *Heber W. Youngken, A. M., Ph. M., Ph. D., Professor of Pharmacognosy and Materia Medica in the Massachusetts College of Pharmacy, Boston, Editor of the Section of Pharmacognosy and Pharmaceutical Botany of "Biological Abstracts," etc.* Third Revision. P. Blakiston's Son and Company Philadelphia, 1929.

This new edition of Youngken's Pharmacognosy is, like the former editions, splendidly bound, printed on handsome paper in a particularly clear legible type. The pictures are also a special feature of the book. Including drawings there are more than one thousand illustrations, and it would be difficult to find anywhere finer photographs of plants and plant structures.

Professor Youngken's interest in botany has tended to make the purely botanical descriptions more extensive than is usual in such manuals. The details of the production and commerce in connection

with the important drugs are also well given. An introduction to the history of pharmacognosy is likewise a feature of the book and is probably the only consideration of the subject in English.

The section on microanalysis seems somewhat brief and it would be convenient to include in it the recognition characteristics of the principal powdered drugs in a convenient tabulated form. A more detailed description of apparatus used and the exact technique of microanalysis would also be helpful.

In general the book is an unusually excellent textbook and in view of Professor Youngken's high reputation for thorough and painstaking research, may be considered a most authoritative source of information on the origin, history, and characteristics of crude drugs of plant and animal origin.

**ALLERGIC DISEASES**, by *Ray M. Balyeat, M. A., M. D., F. A. C. P., Lecturer on Allergic Diseases in the University of Oklahoma Medical School; Consulting Physician to St. Anthony's Hospital, and to the State University Hospital, Oklahoma City, etc.* Third Edition. F. A. Davis Company, Philadelphia, 1930. Price, \$5.

The live interest of the profession in allergic diseases is indicated by the rapid exhaustion of the second edition of this book.

Much advancement has been made in recent years in the discovery of new methods of determining the cause of allergic conditions other than hay fever and asthma, namely, eczema, migraine, urticaria, and certain forms of mucous colitis. Eight new chapters in this edition are devoted to these latter diseases.

Those wishing to acquire an extensive fund of information on the practical clinical phases of allergic conditions will find Doctor Balyeat's new edition a very valuable monograph.

**THE INTERNATIONAL MEDICAL ANNUAL, 1930.** William Wood and Company, New York, 1930.

This is a splendid annual, containing an enormous amount of information on the most recent advances in all branches of medicine and surgery. Its name is somewhat misleading, since all but 2 of the 33 contributors to this "International" Annual are physicians of the British Empire. The two exceptions are Prof. René Leriche and Dr. René Fontane, of Strasbourg. These two have contributed an article of unusual interest and merit on the subject of periarterial sympathectomy.

The contributors have abstracted a large number of the more important articles that appeared in the medical literature of various countries during the year.



COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION, edited by Mrs. M. H. Mellish, Richard M. Hewitt, B. A., M. A., M. D., and Mildred A. Felker, B. S. Volume XXI, 1929. W. B. Saunders Co., Philadelphia, 1930.

Of 471 recent papers from the Mayo Clinic, 90 were selected to be reprinted in full in this volume. Twenty-three others are abridged, 68 are abstracted, and 290 references are given.

The editors, as in the previous 20 volumes, have selected that material which might prove of most service to the general practitioner, diagnostician, and general surgeon.



# THE DIVISION OF PREVENTIVE MEDICINE

Capt. W. H. BELL, Medical Corps, United States Navy, in charge

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## NOTES ON PREVENTIVE MEDICINE FOR MEDICAL OFFICERS, UNITED STATES NAVY

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### TUBERCULOSIS<sup>1</sup>

#### PART III

By M. A. STUART, Captain, Medical Corps, United States Navy

The pathology of tuberculosis is characterized by great diversity or multiplicity of lesions resulting from the specific infection. It may vary from a microscopical mass of cells containing a small number of tubercle bacilli through the intermediate stages to an organ sparsely or thickly studded with tubercles, or, as Krause (1) mentions, to a lung with upper lobe converted into one large cavity with dirty, shaggy lining, while the mid-lung stands out airless, dense, and firm, gray shading into yellow, white, or even green, the entire area perhaps thrown into relief by an edge of more livid red than that of normal lung. On examining macroscopically the cut surface from mid-lung to base, small nodules of varied size, consistency, and color, passing from large to minute, from soft to firm, from yellow to white or gray, are found running out to caudal tip. On the basis of gross morphological comparisons and relations alone there is no common bond between the more manifest pathological possibilities of the disease.

Tissue changes which are observed at different times and under different circumstances as entering into the reactions of the animal body to tubercle bacilli, include practically every fundamental pathological process with which we are familiar. "Proliferation, exudation, degeneration, necrosis, liquefaction, and cavitation, and repair by fibrosis, calcification, or even with the formation of cartilage and bone," writes Krause, may all play a part in tuberculosis. On the one hand, it is possible to obtain, for a time at least, a lesion

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<sup>1</sup> Parts I and II appeared in the April and October, 1929, numbers, respectively. Part IV will appear in a forthcoming number.

which is as purely proliferative as a tumor, and on the other hand a purely exudative lesion, while between these extremes every possible combination of proliferation and exudation may exist.

Comparatively little is known of the life history of the tubercle bacillus during the first few days after natural infection takes place. In a previous article it was stated that the bacilli are taken up and carried by wandering cells of various types through the lymphatic channels, lymph nodes, and finally into the blood stream. Many writers have called attention to the activities of the polymorphonuclear cells in the course of artificial infection but later observations indicate that the monocyte is the most important wandering cell in the transportation of tubercle bacilli and that when tubercles become apparent as physical entities, it is the epithelioid cell that is the most striking.

Rich and McCordock (2) state that they have searched the lungs of many infants and children in the effort to find a lesion of first infection in an early stage of development, but have not yet been able to "surprise" a primary lesion before caseation had occurred. The earliest primary nodule which they have had an opportunity of studying was a small, freshly caseous mass containing many polymorphonuclear leukocytes and nuclear fragments, and surrounded by a zone of very fresh granulation tissue which consisted chiefly of sprouting capillaries and wandering mononuclear cells. Nearby were several large tubercles which were composed of plump epithelioid cells and were beginning to undergo central caseation. Aside from lesions of the same appearance in the bronchial lymph nodes, they could not find other tuberculous lesions in the body. While unable to speak with certainty about the earliest appearance of these lesions in the human being, these authors believe that their origin obeys the general laws which govern the first reaction to the bacillus in the lung of any susceptible animal.

With the knowledge, according to White (3), that the epithelioid cell is the outstanding feature of the early formation of tubercles in the body and that the characteristics of this cell are similar to those described for the monocyte, one would expect that in the animal body tubercles would form wherever this cell has its greatest round of activity. This is actually the case, for in the spleen, lungs, lymph nodes, and parts of the bone marrow we have by far the greatest expression of tubercle infection, and these are the regions of greatest frequency of this type of cell. They are, however, probably found any place where blood and lymph flows and where mesoblast exists.

Chance may land such a tubercle bacillus laden cell in any spot, but the locations of predilection still correspond with the sites men-

tioned above. As Krause states, location and location alone will determine the ultimate issue in any particular case. Again, according to White, any attempt to follow step by step the course of this parasite after landing on the surface, respiratory mucous membranes, etc., of the body would be as follows:

"1. Any phagocytic cell may transport the parasite from the surface to the interior.

"2. The parasite, if carried by a monocyte, is likely to live and multiply; carried by another type of phagocyte and disgorged if it be reabsorbed by a monocyte while still viable, it is likely to live and multiply.

"3. Once within the monocyte, the parasite probably finds its natural environment and begins to multiply.

"4. By virtue of its symbiotic invader, the monocyte at the same time undergoes certain changes: It swells, becomes sluggish in its movement and exhibits certain physical changes such as segregation of fat and multiplication of nuclei.

"5. Carrying its burden along its ordinary channels of activity, it reaches a point which it is unable to pass because either the channel is too narrow for the swollen cell or the cell itself becomes too sluggish or too sticky to move farther. This is probably what Maximow had in mind when he called it the 'resting, wandering cell.'

"6. Shortly after it comes to rest a change in its environment occurs as shown by a clearing of the area about it, described by Kostenitsch and Wolkow and Krause, which is apparent under the microscope. This clearing results probably from an exudate from neighboring vessels caused by change in the reaction or pH value of the area in which the cell has stopped.

"Such a resting place with its resulting environment of exudate is probably the beginning of a tubercle. We have no definite proof of the steps of the process, but the tubercle soon appears as a collection of cells similar to that carrying the original infecting tubercle bacilli." White states that in causing such a collection of cells, two physical factors are within the range of possibility. The exudate which surrounds the infecting wandering cell when it comes to rest may, by contact with an injured cell, begin the process of fibrillar coagulation described by Hertzler (4) and others. The fibrils of this coagulation may influence by differences in surface tension and adhesion (thigmotaxis) the arrest of other cells of the same type which may happen to pass in their ordinary run of activity. Any of these cells may become the host to tubercle bacilli disgorged by the primary cell. The problem of surface tension and adhesion may readily be a physical factor in the collection of cells in beginning tubercle formation.

The other possibility is that the primary cell with its contained parasites may, when it lodges, become a stimulus to multiplication in the immediate vicinity of the same type of cell by virtue of some chemical produced through the combination of host and parasite. While it is probable that both processes occur, the latter is more likely because in some animals there is such a distinctive zone of small lymphocytes in later periods of tubercle development.

According to Rich and McCordock (2) acute allergic exudative inflammation is a complicated specific type of reaction and tubercle formation is a separate and distinct process. The tubercle bacillus injected into lower animals at a stage in their economy when a vascular, circulatory response can not take place, calls forth phagocytosis and true tubercle formation, with a central giant cell and surrounding mononuclear phagocytes before any necrosis can occur. The tubercle, therefore, may be considered to be the most primitive organized reaction to invading microorganisms. It is only higher in the scale that the vascular inflammatory mechanism is developed. Acute inflammation involves primarily a vascular reaction and does not imply any tendency to the formation of tubercles. The latter is incited by the lipoid extracted from the bacillus, but this lipoid can not evoke the allergic reaction. For that, tuberculo-protein is necessary. Although tuberculo-protein produces the allergic inflammatory reaction in the sensitized body, it never causes the formation of tubercles. If, however, lipoid happens to be present at the site of action of tuberculo-protein in the allergic body, tubercles will be formed and formed more rapidly than in the normal body merely because the tuberculo-protein incites, in the allergic body, a more rapid migration of cells to the spot. The above workers have never observed tubercle formation at the site of allergic reactions produced by lipoid-free tuberculins. In this connection, Emerson, writing in the *Journal of the American Medical Association*, March 15, 1930, states that a specific reaction follows the introduction into a normal animal of the pure protein substance isolated both from the tubercle bacillus itself and from the medium on which it was grown but that an entirely different result has been found from the introduction of a fat fraction from the bacillus. It has been shown that this fraction stimulates the monocyte to growth far beyond that of the other cells which make up the animal body. It has also been shown that the polysaccharides of the human tubercle bacillus possess a killing power for tuberculous animals.

Rich and McCordock (2) believe that tubercles may be formed either intravascularly or extravascularly. As an example, they state that within the liver lobule, tubercles always arise within the capillaries. If tubercle bacilli are injected into an animal and only

one or two lodge at a single site, the first step is always phagocytosis of the bacilli, usually by a mononuclear phagocyte, although they may be temporarily engulfed by polymorphonuclear leukocytes. This is frequently followed by the enlargement and division of the nucleus of the phagocyte, and by the accumulation of other mononuclear phagocytes about it. All of these clustering cells divide and take on the appearance of epithelioid cells. Lewis, Willis, and Lewis (5) and others have demonstrated conclusively the formation of epithelioid cells from mononuclear phagocytes, and Rich and McCordock (2) have confirmed the fact repeatedly in their studies with vital stains. The latter state that the original phagocyte, which by its swelling and nuclear division may appear as a giant cell, is usually killed, and the giant cells of the fully formed tubercle arise from similar changes in the surrounding mononuclear cells which have come either from the blood or from the tissues, or by fusion with neighboring mononuclear cells. They believe that ordinary capillary endothelium, no matter where located, does not give rise to any of the cells of the tubercle, that the results of the most careful and reliable investigation is entirely against the participation of any epithelium in tubercle formation, and that recent work repudiates the idea of participation, in any way, of the alveolar epithelium of the lung in intra-alveolar phagocytosis.

*Hypersensitiveness to tuberculo-protein; allergy and resistance.*—For the tubercle bacillus to produce progressive, spreading lesions in the animal body it is not only necessary that the bacillus survive but also that it propagate freely, for extensive lesions are out of the question unless this takes place. If the bacillus does live and grow freely in the body for any length of time, damaging lesions will unfaillingly result.

Most American and many European investigators believe that resistance to the proliferation of the tubercle bacillus within the body acquired through infection with that microorganism is largely a result of allergy which also appears a short time after infection.

If a normal guinea pig is inoculated intracutaneously with tubercle bacilli, writes Krause (1), no immediate reaction except a very transient one occurs. For about a week the point of inoculation remains apparently normal and then a very small papule is noticed as a discrete formation on a noninflamed background. Progressing sluggishly it becomes at first a stony hard and comparatively pale nodule which gradually increases in size and redness. By the end of 15 days the nodule has developed into a tubercle and is a well-defined firm rounded mass overlying otherwise perfectly normal skin. This reaction is of comparatively slow growth and its character is more of the nature of proliferation than of inflammation.

The sequence of events, according to Krause, is quite different if an animal already tuberculous is reinfected. Then, the first visible result is not a proliferative tubercle but a very rapidly developing inflammation. Within certain limits of dosage, this reaction is constant and can be observed in a guinea pig that has suffered a slight, nonprogressive primary infection and is more or less comparable to what more commonly obtains in the human being. It occurs, Krause states, not only under these conditions, but in any tuberculous guinea pig, no matter what the character of the latter's lesions may be. If such animals are inoculated intracutaneously with living tubercle bacilli, an inflammatory reaction will become apparent at the site of inoculation in from about 6 to 12 hours later. By the end of 24 hours, as a rule, this inflammation will have reached its height, which it will maintain for 12 or 24 hours longer. The intensity and extent of this reaction will vary directly with the number of bacilli injected. Thus, if the dose is extremely minute there will be no visible effect, but if the dose is massive, the inflammation will be extreme and will partake of a hemorrhagic nature with rapid necrosis, and in some instances the formation and casting off of a slough. This reaction is a manifestation of the phenomenon designated as allergy. It is little short of amazing, writes Krause, how few bacilli will produce an appreciable inflammation. Certainly a few hundred in the proper animal will do so.

Under the influence of a preexisting focus of infection, this author continues, and only when such a focus has been established, animal tissues take on an entirely new capacity of reacting to tubercle bacilli or any of their dissociated protein products, such as the tuberculins. The first response of a previously infected hypersensitive or allergic animal is an exudative inflammation, and not tubercle, which is proliferative in character and the first visible result of primary infection. He is of the opinion that the exudative type of tissue reaction which is a function of allergy can occur only on condition that the allergic state is in existence at the time of infection. If an animal is hypersensitive, it will always respond at once with a true inflammation, provided the reinfesting bacilli from exogenous or endogenous sources are in sufficient numbers. The extent and intensity of the reaction will be determined, on the one hand, by the numbers of bacilli and, on the other, by the degree of hypersensitiveness of the tissues at the time of reinfection. If an animal is nontuberculous, it will never react to first infection immediately with an inflammation. No matter how large the infecting dose, the first characteristic response will be of a proliferative character. It may be noted that after about two weeks the primarily infected laboratory animal will become allergic by reason of the tubercles that have developed. The habit of reacting exudatively to reinfec-



tion is not confined to the skin and mucous membranes. It may be assumed from evidence obtained from experiments with laboratory animals that all the tissues in the body acquire the same altered reacting capacity, though quite likely to a variable degree. Krause also states that quantitative relations to dosage of bacilli are not significant in so far as the characteristic reaction to first infection is concerned, but as regards the anatomic result of reinfection much will depend on the numbers of reinfecting microorganisms. Even though allergy may be high, the reinfecting dose of tubercle bacilli may be reduced to the point where reinfection occurs and extends without early gross exudation. The preceding paragraphs indicate that the normal uninfected body reacts to the bacillus by tubercle formation and never by acute inflammation, while by this latter process the infected body is thought to have acquired a new capacity of reacting to the bacillus or its products.

Rich and McCordock (2), from the results of their observations and experiments, do not question the concept that, following infection, the body acquires an altered reactivity or "altered attitude" toward the bacillus but consider this altered activity to be essentially quantitative rather than qualitative. It is not an accurate generalization, they believe, to say that the reaction to the first contact with the bacillus is always tubercle formation, and that exudative inflammation never occurs except in the allergic animal. They hold that either the normal or the allergic animal can respond to the tubercle bacillus with either tubercle formation or exudative inflammation. Which type of reaction will occur primarily in any instance will depend greatly upon the number of bacilli and where they lodge. They cite as an example that if a certain quantity of tubercle bacilli, suspended in physiological saline solution, is passed intratracheally into the lung of a normal animal, an acute tuberculous pneumonia (polymorphonuclear and mononuclear exudate) with slight early necrosis of the exudate will occur. The same suspension of bacilli introduced into the lungs of allergic animals calls forth precisely the same reaction, but in this case the exudate is more plentiful, it reaches its height earlier, and necrosis is more prominent. Injection of saline alone leads to no such reaction in either case. On the other hand, if a thin suspension of bacilli is injected into the blood stream of a normal animal, tubercles accompanied by no appreciable acute inflammatory reaction develop in the liver sinusoids. The reaction in the liver of the allergic animal after the same injection differs in no way qualitatively from that in the normal, since tubercles are formed in the absence of acute inflammation, as can be determined by killing off individual animals of a series at different periods after the injection. When doses which are not too large are used, the

only detectable difference between the character of the reaction in the liver of the normal and of the allergic animal is that the tubercles may develop more rapidly in the latter. These authors conclude that with adequate dosage in the proper location, the normal animal may respond to the bacillus with acute inflammation and the allergic animal may react only with tubercle formation.

Referring to the term "allergy" in this connection, Rich states that the infected body becomes changed in some manner which renders the relatively bland protein of the tubercle bacillus capable of acting upon its tissues as a powerful irritant and poison. As a result of this change, the cells of the allergic body are more extensively damaged and killed by a given amount of tuberculoprotein than are the cells of the normal body; and furthermore, because of this enhanced irritant action of tuberculoprotein on allergic tissues and because of the resulting more extensive damage and death of cells, there appears a more violent acute inflammation at the site of action of tuberculoprotein in the allergic body. More extensive damage and death of cells, and more extensive acute inflammation constitute, therefore, the local visible expression of the action of allergy. Constitutionally, the greater irritative effect of tuberculoprotein upon the allergic body is manifested by the fact that fever, malaise, prostration, and even death will ensue when an amount of tuberculoprotein which is harmless for the normal body finds its way into the blood stream of the allergic one.

As a summary, it may be stated that when sufficient numbers of tubercle bacilli are introduced into animals rendered allergic by infection with living bacilli, necrosis, accompanied by a severe acute inflammatory reaction, occurs at the site. With very small numbers of bacilli, gross inflammation, and necrosis are minimal, or may be entirely absent, and a tubercle may be the only visible response to the organisms. Tubercles in both allergic and nonallergic animals are similar except that their growth is more rapid in the former.

Aside from these histological changes, tubercle bacilli introduced into the body of an infected animal appear to become localized at the site, to spread less rapidly and are undoubtedly less able to survive than in the tissues of a normal animal. Krause and Willis (6) demonstrated that in a previously normal animal the lymph nodes draining a cutaneous site of infection were capable of infecting other normal guinea pigs when excised and inoculated as early as 24 hours after the introduction of the bacilli into the skin, whereas regional nodes from similarly treated sensitized or immune animals were not infective before the end of two weeks after the cutaneous inoculation.

This "local fixation" of bacilli in the immune animal has been explained on the ground that the allergic inflammation mechanically

limits the spread of bacilli from the site of inoculation. Baumgarten, however, found that inoculation of tubercle bacilli into areas of nonspecific inflammation furthered, rather than prevented, their spread. Krause and Willis, in experiments reported about nine years ago, produced allergic reactions with tuberculin in the skin of immunized animals, and injected virulent tubercle bacilli into these areas. They controlled the experiment by injecting the same dose of bacilli into the uninflamed skin of other immunized animals. They found that when the injections were made into areas of prepared inflammation, those animals developed more widespread tuberculosis than did the controls. Rich and McCordock have failed to observe any difference between the numbers of stainable bacilli in the local lesions of normal and of immune animals during the first day or two following intracutaneous inoculations. After this time the number of bacilli in the lesions of the nonimmune animals increasingly surpasses that in the lesions of the immunes and, in the latter, bacilli are exceedingly hard to find after the lapse of a week or more. The study of regional lymph nodes of allergic inflammatory lesions in the human being with acquired resistance always reveals the sinuses of the nodes full of cells and débris drained from the lesions, while bacilli in such nodes are usually very hard to find. They believe that if bacilli are actually held fixed, locally, in the lesions drained by the nodes, it must be by means of some specific mechanism, possibly precipitinlike, rather than by a mechanical obstruction of inflammatory exudate, and suggest that the apparent fixation may be interpreted on the basis of the well established fact that a much greater destruction of bacilli occurs in immune animals than in normal ones. It should be mentioned that acquired resistance or immunity to tuberculosis is only relative. Infected animals can always be killed with progressive lesions by a sufficiently large dose of bacilli. Although they may survive a small dose which would kill a control, their resistance with larger doses is evidenced only by a longer survival than similarly infected controls, and they eventually die from progressive tuberculosis.

For the development of manifest allergy, sensitization with the whole bodies of tubercle bacilli has been necessary. It is well known that this reaction will follow the injection of living bacilli. It is stated that inoculation with dead bacilli will produce as great a degree of hypersensitiveness, which is also durable, as that evoked by inoculation with living bacilli. Petroff and Stewart (7) write in this connection that "the local cutaneous allergic reaction in animals sensitized with dead bacilli varies in no way from that in infected animals." Bohart (8) found that killed tubercle bacilli are effective sensitizers under certain conditions. Bacilli killed by

certain chemicals, such as carbol-fuchsin or ether, were the most efficient. A satisfactory reaction has not been successfully accomplished by the injection of tuberculin into the normal body. Any explanation of the mechanism of allergy, according to Rich and McCordock (2), must at least account for the three observed reaction tendencies of the allergic body exposed to the bacillus; namely, damage and death of cells, inflammation, and accelerated tubercle formation. While the latter process tends to aid mechanically in preventing the spread of the bacilli inclosed in each tubercle, it is not considered either a fundamental or a decisive factor in acquired resistance. The products of the tubercle bacillus are exceedingly poisonous to the allergic body. Rich and McCordock (2), while not questioning the benefit of acute allergic reaction to the hypersensitive body, hold that the prompt outpouring of an inflammatory exudate wherever those products come in contact with the tissues can serve to dilute and to restrict the action of the injurious agent. They believe that this inflammation appears to be directed primarily toward the neutralization of the noxious effects which tuberculoprotein exerts upon the hypersensitive body, rather than to a bactericidal action against the intact, living bacillus and that the allergic state represents an increased capacity on the part of the tissues to react, not against living bacilli, but to a bacterial antigen which is liberated as a result of the disintegration of the bacilli. In other words, the sequence of events following the lodging of bacilli anywhere in the infected body is first the action of resistance leading to death of bacilli; second, the allergic response of the tissues which have become sensitized to the products of disintegration of the bacilli. They also believe that acquired resistance is another mechanism which develops after infection, usually coincidentally with, but separately from, the allergic sensitization. In favor of the idea that "immunity is achieved through allergy," there is really only the fact that in the experimental animal both immunity and allergy appear about the same time after infection, and that they are usually coexistent thereafter.

There is evidence against the view that resistance is determined by allergy. As stated before, the work of Petroff and Stewart shows that while animals inoculated with dead tubercle bacilli develop hypersensitiveness to as great an extent as animals inoculated with living bacilli, their resistance is distinctly less. Also, Calmette states that although allergy may disappear some time after a protective inoculation with his B C G bacillus of low virulence, the acquired immunity persists. In autopsy material from women who died during pregnancy or the puerperium from rapidly extending tuberculous lesions, Rich and McCordock (2) found that they usually

possessed a high degree of allergy as shown by the presence of marked inflammatory-necrotic lesions. The extension of the disease, however, was undoubtedly due to lowered resistance. The foregoing observations together with other facts appear to indicate, according to the above workers, that the death and the restriction of growth of the tubercle bacillus are effected by some separate and independent mechanism which does not always parallel in intensity the development of allergic hypersensitiveness, and that an identical and high degree of allergy may exist in individuals who exhibit very different degrees of acquired resistance. They state, "whatever may be our interpretation of the purpose of hypersensitiveness, the allergic reaction is an evidence not of greater resistance of the individual tissue cells to the products of the bacillus, but of greater susceptibility." The infected body becomes resistant to living tubercle bacilli, preventing their growth and causing their death more readily than does the normal body, and at the same time this resistant body becomes sensitized to the bacterial products resulting from the death and disintegration of the bacilli. In other words, it is resistant to living bacilli but hypersusceptible to tuberculoprotein.

Whether allergy, once established, is ever completely lost can not be stated. There is ample evidence that allergy as tested by the tuberculin skin reaction, may diminish during active infection to the point where relatively enormous doses of tuberculin fail to produce more reaction than in normals. It has been estimated that from 3 to 5 per cent of cases of miliary tuberculosis fail to react to doses of tuberculin larger than are ordinarily given to a tuberculosis patient. Aside from decrease of reactivity during certain intercurrent infections and in the moribund, allergy diminishes, especially under conditions of massive tuberculous infection. Rich and McCordock (2) consider it probable that diminution of allergy during massive infection is a desensitization phenomenon dependent upon the combining of most of the available antibody by the large amounts of antigen liberated into the blood stream. Residence in the allergic resistant body apparently has no effect upon the disease-producing power of the tubercle bacillus regardless of the state of allergy or resistance and regardless of the character of the lesion from which the bacilli are taken.

*Repair.*—The processes concerned in the formation of the tubercle have already been described. As the tubercle grows older, the production of fibrous tissue occurs, beginning usually at the periphery where bacilli are fewer in number. It is stated that reticulum is laid down in tubercles before fibrous tissue. Several investigators have commented upon the transition of reticulum into connective tissue. Rich and McCordock (2) have frequently ob-

served this change and state that reticulum can easily be demonstrated by means of Foot's (9) method, in very small tubercles which appear to consist entirely of epithelioid cells. They have repeatedly seen, in common with others, that, in tissue cultures, mononuclear phagocytes can assume the shapes of "fibroblasts," develop fiberlike prolongations, and form a compact tissue. In this connection Maximow (10) has reported that he has been able to demonstrate the appearance of reticulum and collagen fibrillae in tissue cultures of the mononuclear phagocytes of the blood. These wandering phagocytes may, therefore, be able to form connective tissue by first laying down reticulum but further conformation of this process is required.

It is generally believed that the most probable explanation of allergic inflammation and necrosis is that it is the result of an antibody-antigen reaction in which the tuberculo-protein constitutes the antigen which reacts with an antibody formed during infection. According to this view, the plasma and tissue fluids might contain an antibody capable of acting upon the bacillary antigen to yield an irritating substance toxic for perfectly normal cells. This has not been proved. A second possibility is that the active antibody is bound to the tissue cells in such a way that the antigen-antibody reaction leading to the formation of the injurious substance takes place actually within or upon the cells. It is finally conceivable that cellular damage is a result of a similar reaction dependent upon antibodies present in both the tissue cells and in the body fluids. Rich and Lewis (11) applied the method of tissue culture to the study of this problem.

Thoroughly washed fixed tissue and blood cells of allergic and of normal guinea pigs were placed for culture in the plasma of allergic and of normal animals, and the same amount of tuberculin was added to all of the cultures. In this manner, normal and allergic cells were exposed to tuberculin while surrounded by normal and by allergic plasma. The results of hundreds of such cultures showed clearly that the cells from allergic animals were regularly and promptly killed when exposed to tuberculin, regardless of the plasma in which they were placed; while the cells from normal animals, regardless of the plasma in which they were placed, remained alive and multiplied when exposed to the same concentration of tuberculin which rapidly killed the allergic cells. Both the normal and the allergic cells were unaffected by exposure to the glycerine-broth control fluid. It is the damage and death of allergic cells exposed to tuberculin; the individual cells of the various tissues of the allergic body are themselves actually hypersensitive to tuberculo-protein. Allergy, therefore, resides in the cells.

The immediate allergic inflammatory reaction is often followed by a proliferative process ending in the formation of tubercles, in fibrosis, or in encapsulation of necrotic débris. Tubercle formation, according to Rich and McCordock, however, is in no sense a form of repair. They consider repair in tuberculosis to be no different from

repair elsewhere and regard encapsulation or scarring as merely the standard attempt of the body to replace destroyed tissue with connective tissue, modified in appearance only by the fact that, being adjacent to the tuberculous foci, it is infected with tubercle bacilli, and its progress retarded by the necrotizing effects of allergy. Any attempt at the formation of connective tissue about a focus of bacilli in the allergic body can be thwarted by the lethal effects of the tuberculoprotein liberated from those bacilli. This interference with repair is furthered by the circumstance that the cells immediately adjacent to a focus of bacilli acquire a much higher degree of sensitiveness to the products of the bacillus than do those at a greater distance.

In the allergic body, therefore, the formation of connective tissue about a tuberculous focus always proceeds under unfavorable local conditions. The success or failure of adequate fibrosis will always depend largely upon the balance between the degree of hypersensitiveness and the amount of tuberculoprotein liberated from the bacilli in the lesion. There is always ample evidence in autopsy material of attempted connective tissue repair about any chronic progressive tuberculous lesion, but the newly forming granulation tissue can often be seen to become necrotic as rapidly as it is formed. It is well known that large doses of tuberculin can be very dangerous when administered to individuals with tuberculosis either active or quiescent because the ensuing inflammation and necrosis about tuberculous foci results in extension of tissue damage and in the spread of bacilli. The above-mentioned authors believe that any beneficial effect which may follow treatment with tuberculin is less referable to perifocal inflammation than to desensitization and will occur only in those cases in which desensitization of a proper degree has been accomplished. If acquired resistance is actually separate from allergic hypersensitiveness, as they believe, and can be left intact after desensitization by tuberculin therapy, one may expect that its effects will be aided by the greater security against necrosis which desensitization assures any connective tissue formed about a lesion.

Rich and McCordock (2) state that unless large numbers of bacilli lodge at the site originally, or unless the lesion is initiated by a few bacilli which multiply until considerable numbers are present, or unless the lesion is initiated by necrotic debris saturated with the tuberculoprotein of large numbers of disintegrated bacilli such as the aspiration of material of this nature from a cavity, caseation will not occur. The extent of necrosis in tuberculous lesions will always be a result of the balance between the degree to which allergy is developed and the local concentration of the bacillary products.

The number of bacilli necessary to effect necrosis will, in general, be inversely proportional to the degree to which allergic hypersensitiveness is developed, but even with very active allergy the number must be more than a mere few.

*Fate of the tubercle.*—The possibilities as to the final outcome of the tubercle, as stated by Rich and McCordock (2), are as follows:

“1. The bacilli may all die out, and the whole become converted into a hyalinized mass. If there has been central necrosis, the necrotic tissue may become calcified, or even ossified with attendant marrow formation.

“2. The bacilli may remain alive in the center, encapsulated by a wall of hyaline scar tissue.

“3. The tubercle may undergo widespread necrosis, with spread of the proliferating bacilli to the surrounding tissues.

“4. The tubercle may resolve and be completely absorbed, leaving no trace. This can occur only before connective tissue appears, but that it can and does occur is unquestionable.”

They are of the opinion that the growth requirements of the various types and strains of tubercle bacilli must be different, and that natural immunity may often depend entirely upon whether a given animal body is able to satisfy those requirements. In the case of acquired resistance to the tubercle bacillus, they feel that the available evidence at present makes it not unlikely that there has occurred in the resistant body some change which places it in a condition which is comparable to that present in natural immunity and which merely renders the body a less favorable medium for parasitism by the tubercle bacillus. There is very good evidence, Rich and McCordock (2) continue, that acquired resistance, although it undoubtedly fluctuates, very rarely disappears completely, once the primary infection has established it. The entire mass of experimental work supports this view, but in the absence of a specific test for resistance other than the introduction of virulent bacilli, the truth of it applied to the human being can not be investigated in any way other than by the comparison of the lesions in human beings with those occurring in animals with and without acquired resistance. Such studies, they believe, lead unfailingly to that conclusion.

*Outcome of the allergic reaction.*—The possibilities as to the outcome of the allergic inflammatory reaction, also as stated by Rich and McCordock (2), are as follows:

“1. If it is mild and all bacilli are killed, the inflammatory exudate may be completely absorbed and the site restored to normal. This is true even of patches of tuberculous pneumonia.



"2. If the reaction is mild and bacilli are left alive at the site, much of the inflammatory exudate is absorbed, but a tubercle or a group of tubercles proceeds to develop about the remaining bacilli.

"3. The reaction may be initiated by a large number of bacilli and may be accompanied by extensive necrosis. In such a case, if many bacilli are left alive, a spreading, progressive lesion results, with abortive peripheral attempts at tubercle formation and repair which are continually thwarted by the extension of the allergic necrosis. If all of the bacilli die, the necrotic area will be subsequently encapsulated by a wall of connective tissue which, during its formation, will have the appearance of ordinary granulation tissue. Between these two extremes there may be found every degree of partial or complete connective-tissue encapsulation, and every degree of tubercle formation in the encapsulating wall, depending upon the number of bacilli that remain alive in the necrotic mass and infect the periphery."

*Lesions of the lung.*—There is no simple method by which it is possible, from an examination of sections of the tissues from a case of tuberculosis, to say with certainty just what had happened to the individual, for, according to Rich and McCordock (2), any lesion found is always the result of (*a*) the number of bacilli originally deposited at the site; (*b*) their virulence; (*c*) the length of time they have been at that particular spot; (*d*) the character of the tissue in which the bacilli lodge; (*e*) the degree of resistance (natural, individual, and acquired) of the individual; and (*f*) the degree of allergy. Of these six factors, at least four are usually undetermined.

The following list of the chief types of lesions occurring in the lungs and the subsequent discussion are based on the work of Rich and McCordock (2). The differences between the childhood and adult types of infection will be taken up later.

#### THE PATHOGENESIS OF LESIONS OCCURRING IN THE LUNG

- I. Encapsulated caseous or calcified nodules of primary infection.
- II. Tubercles.

- A. Compact, well formed ("hard" tubercles).

- 1. Localized in one area of the lung.

- (*a*) Associated with scars in latent lesions.

- (*b*) An extensive but localized mass of tubercles.

- 2. Diffusely scattered throughout both lungs.

- (*a*) Very sparsely distributed (disseminated tubercles).

- (*b*) Profusely distributed (miliary tuberculosis).

**II. Tubercles—Continued.**

B. Loosely formed with tendency to early caseation throughout ("soft" tubercles).

1. Diffusely scattered throughout both lungs.

(a) Profusely distributed (acute caseating miliary tuberculosis).

**III. Tuberculous pneumonia.**

A. Acute exudative.

1. Focal small areas.

(a) Miliary pneumonia.

2. Extensive, but localized area.

3. Involvement of entire lobe.

B. Proliferative.

**IV. Progressive local invasion with destruction of large areas of tissue.**

A. Slowly progressing, with prominent fibrous tissue formation.

1. In adults (chronic phthisis).

2. In children.

(a) From first infection.

(b) From reinfection.

B. Rapidly progressing, with little evidence of repair.

1. In adults.

2. In children.

**I. ENCAPSULATED CASEOUS OR CALCIFIED NODULES OF PRIMARY INFECTION**

These nodules are the characteristic remains of well-resisted primary infections of childhood and are always associated with similar nodules in the regional lymph nodes. They vary in size from several millimeters to 1 or 2 centimeters in diameter and during childhood often contain considerable numbers of stainable bacilli. When the infecting dose has not been too large and growth of the bacilli is successfully restrained by the prompt development of resistance, nonspecific, connective-tissue repair takes place about the lesion, encapsulating it with a wall of fibrous tissue which eventually becomes hyalinized.

Krause maintains that the primary infection always calls forth a true, proliferative nodular tubercle, and Aschoff, together with many continental workers, claims that the primary reaction in the lung is always of the exudative pneumonic type with a marked tendency to caseation. From their experiments with animals, however, Rich and McCordock (2) are certain that the response to a primary infection may be either tubercle formation or inflammatory

pneumonia, depending largely upon the numbers of bacilli and the site at which they lodge. If the bacilli remain out in the alveoli, instead of localizing in the interstitial tissue, a pneumonic process, strictly speaking, will always occur, but when the numbers of the bacilli are not very large it may be a pneumonia in which the alveoli are filled by a leisurely formation of tubercles instead of by an inflammatory exudate. Caseation of the area is contingent upon the development of allergy and upon the presence of a sufficiently large number of bacilli. The entirety of experimental evidence, they state, assures us that a frank caseous pneumonia is not to be expected as an immediate reaction to first infection, for it is a manifestation of allergy, and therefore of reinfection.

In this connection the recent experiments reported by Gardner (12) may be mentioned. He injected tubercle bacilli by the intraperitoneal route into a number of guinea pigs of which some were normal and others were sensitized. He found that the subperitoneal tissues are not exceptional in their behavior to the general principles of reaction to primary infection and to reinfection. These tissues also meet primary infection with a slow proliferation, and reinfection with an inflammation accompanied by accelerated proliferation. Both nonsensitized and sensitized animals respond immediately to the injection of tubercle bacilli with an acute inflammation, but in primary infection this reaction is nonspecific in nature and disappears completely after 48 hours. In reinfection the nonspecific exudation is accentuated by hypersensitiveness, and inflammatory phenomena do not disappear, but continue with increasing severity throughout the course of the disease.

## II. TUBERCLES

A. *Compact, well formed ("hard") tubercles.*—There are two distinct types of minute, nodular tuberculous lesions, according to Rich and McCordock, which they designate as the "hard" tubercle and the "soft" tubercle. The former type is the solid, compact cellular tubercle represented by the familiar lesion composed of concentrically arranged epithelioid cells and usually containing one or more multinuclear giant cells. The latter type is made up of a loose collection of mononuclear cells which tend to suffer early death, so that even minute tubercles of this variety may appear as mere foci of caseation. Necrosis brings about early softening of the nodule in contrast to the increasing firmness which the compact tubercle acquires through the development of reticulum and fibrous tissue.

The hard tubercle may undergo tardy central caseation, and in the instances in which the central necrosis gradually spreads until a large part of the nodule is caseous, it may be impossible to dis-

tinguish the end result from that of the abortively formed soft tubercle in which the more prompt necrosis may be followed by encapsulation. In miliary tuberculosis the two types stand out in striking contrast. In the one case the organs are studded with well formed, typical tubercles with or without foci of necrosis in the centers, while in the other case loosely arranged accumulations of cells with early necrosis of the entire mass are found throughout the tissues.

A. 1. (a) Compact tubercles associated with localized areas of fibrosis are seen commonly in sections of the apical lesions of reinfection in adults. "An old fibrous apical scar may have none of the microscopical characteristics of tuberculosis, but it is easily possible to find in apical lesions, in different cases, all transitions from tubercles to fibrous scars. When tubercles are found in association with these lesions they may be incorporated in scar tissue or they may form a fringe about the margins of a scar. In this latter region they may form within the lumina of adjacent alveoli, or they may extend along the alveolar septa. The presence of indolent tubercles in association with scars is the characteristic effect of relatively few bacilli acting in the face of acquired resistance, and can be produced with ease in the experimental animal by the application of those conditions."

A. 1. (b) Extensive but localized areas of lung tissue made solid by a dense accumulation of myriads of tubercles result from the aspiration of bacilli following the erosion of a large bronchus by an adjacent caseating lesion. Under this condition, the development of acute caseating tuberculous pneumonia may be expected, but with very low or absent allergy, or with the discharge of not too many bacilli, acute inflammation may be transient, necrosis slight, and the formation of masses of epithelioid cells and of true tubercles may proceed sluggishly out in the alveoli. The visual result in this condition, however, is caseous pneumonia, for allergy is nearly always high in progressive tuberculosis, the numbers of bacilli discharged are almost invariably large, and caseous material impregnated with tuberculoprotein is usually discharged along with the bacilli. If the pneumonic exudate undergoes caseation here and there, the necrotic foci may themselves become encapsulated, simulating neighboring true tubercles with central caseation, and the whole may gradually assume the appearance of a large, often wedge-shaped area of tubercles, interlaced in later stages by a considerable meshwork of fibrous tissue. This form of lesion is far more common in children than in adults because of the greater frequency, in the former, of caseating bronchial lymph nodes which may perforate neighboring bronchi and discharge relatively small numbers of viable bacilli, when the bronchial erosion is not large. Rich and McCordock

have occasionally observed in the adult, smaller, irregular foci of this nature resulting from the aspiration of bacilli from a cavity. Caseous pneumonia, however, is much more frequent.

A. 2. (a) These are the sparsely scattered, "disseminated tubercles," the result of a mild bacillemia in the face of resistance, and therefore never found in the absence of an older lesion from which the bacilli were discharged. Of variable size, usually rather old, they are not infrequently fibrosed and hyalinized. The fact that disseminated tubercles are seldom found in the early stages of development fits in with the knowledge that they are the result of the intermittent periods of bacillemia which are known to occur during the course of chronic tuberculosis of any organ. Most of the bacilli fail to thrive or perish where they lodge because of acquired resistance on the part of the host but occasionally they gain a foothold and cause tubercle formation. In every case of chronic progressive tuberculosis of any organ, disseminated tubercles, according to Rich and McCordock, can be found in distant organs if searched for. The condition can be reproduced by injecting a thin suspension of bacilli into the blood stream of an animal with acquired resistance. Although many of the older tubercles may be of the same size, it by no means follows that they are of the same age. The size to which a tubercle will develop often appears to be self-limited. After attaining moderate growth they may remain stationary for a long time, or even permanently, in the animal with acquired resistance.

A. 2. (b) This is true miliary tuberculosis and is the result of a more active blood-stream infection. In contrast to the conception that miliary tuberculosis is always produced by the sudden rupture of a tuberculous focus into a large blood or lymph vessel or from successive "showers" of bacilli from successive sudden eruptions of such foci into vessels, Rich and McCordock believe that even an extreme form of this condition can occur in the absence of such gross vascular involvement. A sudden, acute massive miliary tuberculosis is undoubtedly invariably associated with the sudden eruption of a caseous focus into a macroscopic vessel. They hold that there exists a more insidious form of the disease in which bacilli, entering the blood stream through microscopic vessels in a lesion, colonize here and there in the tissues, with an especial tendency to perivascular localization. They also believe that these new lesions in turn discharge eventually and gradually into the adjacent microscopic vessels. From this gradual dissemination still new foci arise until, in the course of time, myriads of minute discharging foci create the pathological picture of frank miliary tuberculosis. This condition, they state, must be regarded as nothing more or less than the result of a septicemia with the tubercle bacillus.

It is a well-known fact that tubercle bacilli may be cultivated repeatedly not only from the blood of patients with miliary tuberculosis but also from the blood of patients with progressive tuberculosis of any organ. The presence of bacilli continually in the blood indicates one or more continually discharging foci. This is the effect, largely, of the tendency to the perivascular localization of tubercles and because of the chronicity of the condition, time is provided for the extension of such foci into the blood stream. That miliary tuberculosis, once established, is practically never recovered from, is not infrequently the result of this continual progressive infection of small vessels. It is a self-propagating septicemia, very soon progressing independently of the original focus, and the original focus may be a spreading, caseating lesion within an organ, which infects myriads of small vessels as it progresses, quite as well as the more dramatic discharge of bacilli and caseous material into a large vessel.

Rarely, if ever, are all the tubercles found to be of a uniform size. It is sometimes possible to separate them into three or four groups of more or less sharply defined sizes, and it is this factor which has led to the belief that they represent the results of different or successive sudden discharges of bacilli into the blood stream. Sudden, massive discharges of bacilli at different intervals, however, are not necessary, according to Rich and McCordock, to produce the picture of a body studded with tubercles of sharply different sizes. They have repeatedly produced this picture by a single intravenous injection of tubercle bacilli. All of the bacilli are cleaned out of the blood in a very short time, but the number stopping at each site is not always the same and the organs of such animals examined a week or two later will show in each organ, not tubercles of approximately the same size, but of several different sizes and ages. Infection of minute (microscopic) vessels by adjacent tubercles or by tubercles developing in their walls, can always be demonstrated with little effort. In making an offhand survey of a single section of lung in 46 cases of miliary tuberculosis in the human, these workers found microscopic involvement of blood vessels of a character permitting discharge of bacilli into the blood in 20. They state that the finding of an intimal tubercle within a large vessel should never be lightly accepted as the site of origin of a miliary tuberculosis, for most intimal tubercles are circumscribed and covered over with endothelium and do not discharge large numbers of bacilli into the blood.

When bacilli reach the lung by way of the blood stream, in both the normal and the allergic body, the pulmonary tubercle may begin either within the alveolar wall or out in the alveolus itself, depend-

ing upon the site at which the bacilli lodge permanently. Usually, in animals in which the early stages can be studied, both processes can be found in the same lung.

In the human being Rich and McCordock have demonstrated the dual location in material from a small series of cases of extremely fresh miliary tuberculosis. The situation of young tubercles in the alveolar wall was clearly evident. "In these cases, we can show instances of even as few as half a dozen epithelioid cells grouped about a giant cell situated within the alveolar wall, with tubercles of similar character and minuteness in other organs."

Krause and others maintain that, in the allergic individual, bacilli always call forth an allergic exudative reaction or foci of pneumonia, wherever they lodge in the lung, while Rich and McCordock hold that the extent to which exudation will attend the escape of bacilli into the alveoli is determined by the number of bacilli which leak out into the alveoli and by the degree of allergy. Some of the bacilli injected intravenously find their way into the alveolar spaces in both the allergic and the normal animal, and in both, small foci of pneumonia can regularly be found. If they do not resolve, these foci proceed to tubercle formation. Other bacilli, lodging in the alveolar walls, stir up tubercle formation there, in both the allergic and the nonallergic animal. Finally, bacilli engulfed by phagocytes in an alveolus may be carried into the interstitial tissue and initiate tubercle formation there. "The interstitial tubercles naturally encroach very early upon the neighboring alveoli, and may simply obliterate the alveoli by extension; but more commonly, a fringe of pneumonic alveoli appears about the advancing tubercle. The cells of this pneumonia fringe may in turn form a compact epithelioid-cell tissue which is added to the original nonexudative tubercle, and a nodule is formed as a result of a combination of a proliferative and an exudative process. This is especially prominent in the allergic animal, and may be caused by the spilling of bacilli from the interstitial tuberculosis into surrounding alveoli or, since bacilli are often very rare in these collateral foci, it may be at times the result of the liberation of antigen (tuberculoprotein) from the bacilli within the tubercle."

To summarize then, the pulmonary miliary tubercle may begin primarily in the alveolar wall, in the interstitial tissue, or out in the alveolus; but not every minute, encapsulated, pneumonic focus found in cases of miliary tuberculosis is to be regarded as a primary result of blood-stream infection. Many, and in some cases most, of such foci are the result of discharge of bacilli from interstitial tubercles into bronchioles; others are associated with the very common erosion of bronchi by caseating lymph-node lesions.

B. The so-called "soft" tubercle is loosely formed, and is often poor in cells with a tendency to early caseation. Necrosis of even the most minute early accumulations of epithelioid cells often occurs in contradistinction to the usual tardy caseation of the center of a fair-sized tubercle. In their series of 50 cases of miliary tuberculosis in man, Rich and McCordock found 7 in which the tubercles were of the typical "soft" variety. In three cases, the tubercles were on the border line between the "hard" and the "soft" varieties and all transitions between these forms could be found in several cases.

B. 1 (a) This is the "soft" miliary tubercle. It occurs in cases of acute caseating miliary tuberculosis while the compact, well-formed tubercle with tardy central caseation is seen in the usual case of miliary tuberculosis. Every gradation between the extreme hard and soft variety, however, can be found in any large series of cases of miliary tuberculosis and sometimes even in the same case. In the human lung, the soft tubercle begins as a very minute focus of pneumonia which rapidly undergoes caseation. Later, organization or tubercle formation may appear about the periphery of the little caseous mass, eventually encapsulating it.

The differences between the hard and the soft tubercle have been attributed to variations in virulence of the bacilli and of allergy. Some investigators have regarded the soft tubercle as a very early stage of the hard variety. It has been pointed out that numbers of bacilli are of prime importance in determining necrosis in tuberculosis, and that even in the face of extreme hypersensitivity more than a few bacilli are necessary to effect tissue destruction of any appreciable degree. Applying this fact to the problem of the soft tubercle, Rich and McCordock state that since the hard tubercle can develop to a considerable size without necrosis in a highly allergic body the extensive and prompt necrosis of the soft tubercle must be due to the presence of a greater number of bacilli within it. In staining material from human sources they found that bacilli were present in great numbers in soft tubercles, whereas they were always very difficult to find in hard tubercles. In the caseous centers of tubercles in caseous pneumonia which is beginning to be encapsulated, or in caseous lymph nodes, stainable bacilli are very frequently quite scanty or even entirely absent, because they have been destroyed by the body's mechanism of resistance, but in the early stages of the process when necrosis is progressing bacilli are always found in abundance and moreover are undoubtedly multiplying.

The above-named workers have produced soft tubercles in allergic animals by the intravenous injection of suspensions of bacilli in which small clumps were permitted to remain in order to cause the



multiple localization of numbers of organisms. Usually very few allergic animals survive such injections because of the constitutional hypersensitive effects. They have also produced the soft tubercle in animals through preliminary subcutaneous infection of the same animals, by injecting, intravenously, emulsified freshly caseous lymph nodes containing large numbers of bacilli. These experiments, together with the recorded findings in the human being of great numbers of bacilli in the soft tubercle as contrasted with the few in the hard form, apparently leave no doubt that the soft tubercle is merely the result of a massive blood-stream infection in the presence of high allergy. It is probable, under these circumstances, that allergy becomes temporarily depressed, sometimes, as was the case in the animals used in the above experiments, but allergy depressed by sudden desensitization may return quickly and with renewed vigor, as pointed out by Krause and others. In confirmation of their animal experiments, Rich and McCordock found among their human material a case of very fresh acute caseating miliary tuberculosis in which the lesions were represented by very minute cellular accumulations with necrosis. They were able to demonstrate, with ease, small emboli of clumped bacilli and large numbers of individual bacilli in the capillaries of various organs. The fact that minute foci of necrosis containing bacilli were present while bacilli were still circulating in large numbers in the blood shows that even in a case of undoubted eruption of a caseous focus into a large vessel, bacilli continued to be discharged from the focus over a certain period of time. It is only through the rapid discharge of large numbers of bacilli into a large vessel that acute caseating miliary tuberculosis can be produced, for the gradual dissemination of single bacilli will, in the human being as in the experimental animal, cause the production of hard tubercles only, regardless of the state of allergy or resistance, and regardless of the virulence of the infecting microorganism. It does not follow, however, that every microscopic discharging focus of this sort will bring about acute caseating miliary tuberculosis, for such foci may only discharge their bacilli gradually and, furthermore, most of the bacilli contained within them may have perished before the discharge occurs. "We have every reason to expect," write Rich and McCordock, "that when great numbers of bacilli, together with caseous material saturated with tuberculo-protein, are rapidly discharged into a large vessel, the event will be heralded by an abrupt appearance of fever, malaise, and prostration; that is, by an exaggerated constitutional allergic reaction. It will not necessarily follow, however, that the mere presence of discharging macroscopic vascular lesions will always precipitate miliary tuberculosis with acute symptoms. No sudden constitutional symptoms are to be expected with a gradual feeding of bacilli into the circulation."

## III. TUBERCULOUS PNEUMONIA

This condition, according to Rich and McCordock, appears in two histologically distinct forms, although from the standpoint of pathogenesis they can not be so sharply separated. The most common type is characterized by exudation of fluid, mononuclear cells and occasional polymorphonuclear leukocytes into the alveoli, together with the shedding of alveolar epithelium. In the other form, the alveoli become filled with compact plugs of epithelioid cells. The exudate of the former type, which may be termed "exudative pneumonia," is much more likely to undergo caseation. Both types may be transformed into typical tubercles or replaced by connective tissue. The tubercle bacillus more rarely calls forth a form of pneumonia characterized by the purulent nature of the exudate, which is histologically indistinguishable from ordinarily lobular pneumonia. Such foci, in which no other bacteria can be discovered in stained preparations of the exudate, are occasionally seen in lungs containing areas of typical tuberculous pneumonia. This is merely an unusual form of the exudative type. That a purulent exudate may be produced in the lung by the tubercle bacillus is not surprising, according to Rich and McCordock, for purulent pleural effusions of tuberculous origin are well recognized, and further, it is known that sufficient numbers of bacilli injected into the bronchi or under the skin of allergic animals may call forth swarms of polymorphonuclear leukocytes as an immediate reaction. The character and distribution of the pneumonic lesion, and the ultimate fate of the exudate will depend in any case upon the effects of allergy, of resistance, of numbers of bacilli, and of the route by which the bacilli reach the alveoli. It is well known that bacilli, falling by gravity, or drawn by aspiration into alveoli below a cavity, cause, in those alveoli, the exudative type of pneumonia. The above workers introduced into the lungs of allergic and non-allergic rabbits and guinea pigs by way of the trachea and under aseptic precautions, different amounts of various strains of tubercle bacilli suspended in normal saline solution. The animals were killed at various intervals between 24 hours and three weeks following the injection, and the tissues were stained for tubercle bacilli and also for ordinary bacteria. They found that the immediate reaction to the tubercle bacillus is identical in quality, as indicated by the exudation of mononuclear and polymorphonuclear cells, in both the nonallergic and the allergic lung, but in the latter, the exudate is more abundant, reaches its height earlier, and early necrosis is more prominent. Controls in which normal saline alone was injected showed no inflammation at the end of 24 hours or subsequently. Allergy, they state, is not necessary for the occur-

rence of exudative tuberculous pneumonia, but, if present, it greatly intensifies the reaction. It is also true, however, that in most cases of tuberculous pneumonia occurring in man, allergy is present, and by reason of this mechanism, the reaction is greatly intensified and necrosis favored. Soper, Sampson, and Harkins (13) reported corresponding results from their X-ray studies on animals infected through the trachea in a similar manner.

At the end of two weeks and subsequently, following the intratracheal injection of moderate numbers of bacilli, animals with acquired resistance may show distinctly less pneumonia than the originally normal controls, while after small doses, the lung of the animal with acquired resistance may become almost entirely free from lesions and bacilli. The experiments of Rich and McCordock show that small foci of tuberculous pneumonia can resolve as completely as do foci of ordinary lobular pneumonia and Soper and his coworkers have witnessed, during their X-ray studies, the complete resolution of tuberculous pneumonia in immunized animals.

"This resolution is bound up with the mechanism of acquired resistance. One may regard it as certain that, when resistance is sufficient to counteract the numbers and virulence of the bacilli in any group of alveoli, the bacilli will die and resolution will occur if the alveolar walls have not been destroyed during the allergic reaction; if only a few bacilli remain alive in alveoli in which necrosis has not occurred, they will be encapsulated in the alveoli by tubercle formation as the pneumonic inflammation subsides; if caseation has involved the alveolar walls, but only a few bacilli remain alive in the area, encapsulation of the caseous mass by connective tissue will occur; if no bacilli remain alive in the necrotic focus, either encapsulation or complete replacement by connective tissue will result; and, finally, if resistance is insufficient and many bacilli remain alive, the process will spread progressively to neighboring alveoli." Complete resolution can be expected, then, only in those instances in which the numbers of bacilli reaching the alveoli are not sufficient to provoke too violent an allergic reaction, and in which resistance is sufficient to destroy them.

Bacilli which reach the lung by way of the blood stream, in either the allergic or the nonallergic individual, may either lodge in the alveolar wall and produce tubercles, or they may escape here and there into alveoli and produce miliary foci of pneumonia. When they leak from the blood stream through the alveolar wall into the alveoli, an exudate will appear in those alveoli in either the allergic or the nonallergic body, just as happens when bacilli fall into the alveoli through the bronchiole. The exudate in the allergic individual under these circumstances will be qualitatively identical with,

but usually distinctly more prominent and more subject to necrosis than that in the nonallergic one.

Large foci of fresh caseous pneumonia, however, are not to be expected as an immediate result of blood-stream infection of the lung, even in the allergic body, for extensive, necrotizing allergic reactions are not produced by few bacilli, and the number of bacilli shed from the blood into the alveoli at any one point is usually small. Because of the slow growth of the tubercle bacillus, a rapid spread and confluence of originally minute, scattered tuberculous pneumonic lesions, comparable to that familiar in confluent lobular pneumonia produced by the more rapidly proliferating pyogenic bacteria, is quite unknown. That even massive blood-stream infection in the human being does not produce extensive areas of tuberculous pneumonia is clear from the minute size of the foci found in acute caseous miliary tuberculosis following the discharge of great numbers of bacilli into a vein. Even in the more chronic and thorough haematogenous seeding of the lung with bacilli, often seen in extreme degree in the generalized tuberculosis of childhood where the lungs may be uniformly riddled with caseous patches of various ages, these patches are rarely over 5 millimeters in diameter and are usually rather spherical and discrete and are partially or completely encapsulated.

Areas of fresh caseous pneumonia of any extent are not produced in the human being, according to Rich and McCordock, in any other way than by the discharge of bacilli or bacillary products directly into alveoli from older foci in communication with bronchi, for only in this way can great numbers of bacilli reach a large area suddenly. They have never failed to find a discharging focus of this nature in their autopsy material, in cases where large areas of tuberculous pneumonia were present.

It may be pointed out that exudative tuberculous pneumonia may appear in alveoli into which no bacilli have found their way. If bits of caseous material containing no bacilli are discharged into a bronchus from a cavity or a caseous lymph node, a pneumonic exudate will appear in the alveoli into which the material is aspirated, for such necrotic matter is impregnated with tuberculo-protein. Likewise, a fringe of alveoli containing pneumonic exudate in which no bacilli can be found is very commonly seen about tuberculous foci. This collateral inflammation has two possible modes of origin. It may result from the diffusion of tuberculo-protein into the zone immediately surrounding the lesion, for we have produced pneumonic exudates, exactly like those resulting from the injection of bacilli, by introducing tuberculin intratracheally into allergic animals. Or the collateral pneumonia may result from the action of tuberculo-protein absorbed into the circulation from some other lesion, for it is well known that the cells immediately about a tuberculous focus are much more hypersensitive to circulating tuberculin than are any other cells in the body, and that inflammation and even necrosis occurs about tuberculous foci when sufficient amounts of tuberculo-protein are absorbed into the blood stream.

The relations of the acute exudative type may be summarized in the subdivisions which follow.

A. 1. *Disseminated small foci of pneumonia*.—These foci can result from infection of the lung by way of either the blood stream or the bronchi. Irregularly scattered foci of varying size in one

or in both lungs indicate aspiration from a bronchial erosion produced by an older local lesion such as a cavity or a caseous lymph node. According to the experience of Rich and McCordock it is not infrequently necessary to search the lungs carefully by making many thin sections in order to find small cavities from which the aspiration of bacilli has occurred.

A. 1. (a) This is the so-called miliary pneumonia, and is due to the more evenly distributed pneumonic foci throughout both lungs resulting from blood-stream infection. It is especially striking in fresh form in cases of acute caseating miliary tuberculosis.

Any individual minute focus of pneumonia found in association with ordinary miliary tuberculosis may be a direct result of the discharge of bacilli into bronchioles from miliary tubercles involving their walls. The erosion of large bronchi by progressive lesions is common in association with miliary tuberculosis, especially in children, and scattered foci of pneumonia from this source are frequently added to those arising from infection by way of the blood stream and the smaller bronchioles.

A. 2. *An extensive but localized area of pneumonia.*—This condition, when it occurs in one lung, is, in the child, an exceedingly common result of the discharge of caseous material into a large bronchus following its erosion by an adjacent caseous lymph node.

Bacilli are aspirated into the alveoli connected with the ramifications of the eroded bronchus, and consequently a rather sharply outlined area of consolidation results, which often has the shape of a wedge, with the base beneath the pleura. Widespread caseation of the exudate and of the lung tissue usually occurs in the consolidated area, for the number of bacilli aspirated during evacuation of the caseous node is usually large, and allergy high. When caseous material is lost by way of the bronchi from the center of the consolidated mass, cavities are left within it, but this does not always occur. The infection may spread progressively to the lung substance about the area of immediate consolidation or, when the bacilli are held in check by resistance, resolution of exudate in the marginal alveoli, unaffected by caseation, will occur and the remaining caseous mass will become encapsulated by connective tissue. A large area of caseous pneumonia may also result from (a) the progressive spread of a primary infection initiated by large numbers of bacilli, or (b), a delay in the appearance of resistance following primary infection with smaller numbers of bacilli. If the primary lesion in its early advance involves the wall of a bronchus, when caseation appears, as it always does, rapid spread of bacilli by way of the bronchus may occur, with a resulting area of pneumonia involving especially the alveoli associated with the eroded bronchus.

In the adult, less exposed to the danger of erosion of bronchi by caseous lymph nodes, large areas of pneumonia are practically always the result of aspiration of bacilli from a cavity in communication with a large bronchus.

A. 3. *Acute pneumonia involvement of an entire lobe.*—In children, this may result from the discharge of a caseous hilum lymph node into a main bronchus.

In adults, massive aspiration from an apical cavity may, of course, have the same effect. The slow growth of tubercle bacilli makes it highly improbable that the occurrence of acute tuberculous lobar pneumonia depends in any way upon any such obscure factors as those which determine that lobar rather than lobular pneumonia will follow infection with the pneumococcus in a given case. In order to appear rapidly throughout an entire lobe, tubercle bacilli must be actually deposited from the start throughout that lobe.

A more gradual lobar consolidation may result from the continual aspiration over a period of time of smaller numbers of bacilli from lesions situated higher up in the bronchial tree.

B. *The "proliferative" type of tuberculous pneumonia.*—This is a condition in which alveoli become filled with solid plugs of epithelioid cells which form a coherent tissue resembling that of the tubercle, as contrasted with the loose inflammatory exudate seen in the ordinary tuberculous pneumonia. The process, according to Rich and McCordock, actually represents tubercle formation proceeding out into the lumen of the alveolus and forming a cast of the alveolar tree instead of a spherical nodule. Certainly, the same factors which favor tubercle formation favor the development of this form of pneumonia. Since it has been pointed out that large numbers of bacilli and a high allergic state tend, in general, toward the exudative type of reaction with early necrosis, and that reverse conditions favor the proliferative type of reaction, one may expect the proliferative type of pneumonia (*a*) in cases in which relatively few bacilli reach, and remain in, the alveoli; (*b*) in those in which allergy is low or absent; and (*c*) in those in which a very few bacilli are left in the alveoli after a mild allergic inflammation, or exudative pneumonia, has run its course, since it is well known that a tubercle will develop at the site of an allergic reaction if a few living bacilli remain after the reaction has subsided.

IV. A. 1. *Slowly progressing local invasion in adults with prominent fibrous tissue formation. (Chronic phthisis).*—The pulmonary lesions of adult life in civilized communities are almost invariably lesions of reinfection, and begin, as a rule, at or near the apex of the lung. Whatever the nature of the immediate reaction to the deposition of bacilli, it undoubtedly depends upon the principles in regard to the balance between the degree of allergy and the numbers of microorganisms deposited. Since the apical lesions develop under the influence of some degree of acquired resistance, and since they are practically never the result of sudden massive infection, they very soon show evidence of fibrosis. The presence of indolent tubercles in association with scars is the characteristic effect of relatively few bacilli acting in the presence of acquired resistance.

With the ultimate death of the contained bacilli, these tubercles may themselves become replaced by fibrous tissue, and this process is commonly seen

in lesions which are undergoing transformation into the familiar obsolete apical scar. On the other hand, when larger numbers of bacilli are present in the advancing margins of such lesions, neighboring alveoli will contain a pneumonic exudate characteristic of the allergic effect of the escape of a larger number of bacilli, or the diffusion of a larger amount of tuberculo-protein into the alveoli. This is commonly seen about apical lesions which are spreading progressively toward manifest phthisis. The pneumonic exudate and the surrounding alveolar walls may or may not undergo caseation. The degree to which that event will occur hangs upon the balance between the numbers of bacilli and the degree of allergy. In progressive apical lesions caseation does usually occur to some extent, and the caseated areas produced here and there commonly become encapsulated and are left behind the advancing margin, embedded in fibrous tissue. Slowly progressing lesions of this sort may reach a very considerable size while retaining throughout the character of scar tissue with embedded foci of caseation and tubercles, with an advancing margin composed of a fringe of alveoli containing fresh and organizing tuberculous pneumonia and tubercles. When a caseating focus in the advancing margin of such lesions involves by chance the wall of a bronchiole, the opportunity for more widespread extension of damage is greatly favored by the discharge of bacilli into the air channel. When the wall of a larger bronchus is involved in this manner, the evacuation of the necrotic material provides the condition necessary for the beginning of a cavity which, depending upon the numbers and virulence of the bacilli, and the degree of allergy and of acquired resistance, may remain quite minute or may become very large through progressive destruction of the reparative attempts about it.

A. 2. (a) *Fibrosis and cavity formation in children, from first infection.*—Pulmonary lesions with very prominent fibrosis and the formation of a well walled-off cavity, either quite small or of considerable size, with a network of bared blood vessels and bronchi are exceptional in young children, but Rich and McCordock state that in their material, lesions of the above type have been by no means so very rare. In the great majority of cases, lesions of this character have resulted from the gradual spread of a primary pulmonary infection which was unsuccessfully resisted. That this is the case is clear from the facts that (a) they may be found anywhere in the lung; (b) the lymph nodes draining the lesion show marked involvement; (c) minute search may fail to disclose any other primary lesion; and (d) there is no evidence of the origin of the condition from a discharge of bacilli from a caseous node into a bronchus. As a rule, the lymph nodes at the hilum reflect the character of the chronic process within the lung. They show considerable caseation but they are not extremely large, and scarring and hyalinization are very prominent. These lesions occupy a place midway between those primary lesions which promptly become well-encapsulated, and those with little evidence of peripheral repair.

A. 2. (b) *Cavity formation associated with fibrosis, in children.*—This condition may result from the influence of those factors previously mentioned which determine steady progress toward exten-

sive caseation with little evidence of peripheral repair. It may also result from reinfection of the lung following the discharge of bacilli from a caseous lymph node into a bronchus, the ultimate effect depending upon allergy, resistance and dosage of bacilli discharged. Cavity formation with prominent fibrosis, according to the experience of Rich and McCordock, however, has been much more commonly the result of progression of the primary pulmonary lesion, with no evidence of bronchial involvement by caseous lymph nodes. Cases of fibrosis and cavity formation resulting from hematogenous reinfection of the lung from within, or from reinfection from without by aspiration of fresh tubercle bacilli, and corresponding to adult phthisis in the slight involvement of the regional lymph nodes, are excessively rare before adolescence. There is also a type of slowly progressing local invasion and destruction of large areas of lung tissue which results from the direct extension of infection from a hilum lymph node.

Even very large, completely caseous lymph nodes in contact with the lung are usually quite sharply separated from the lung tissue by a fibrous capsule. Sometimes, of course, caseation strikes the capsule itself and advances through the wall of an adjacent bronchus or out into the parenchyma of the lung, spreading large numbers of bacilli and producing rapidly destructive lesions. But when smaller numbers of bacilli escape into adjacent lung tissue as a result of a more gradual capsular disintegration, instead of rapidly progressing caseating lesions, foci of pneumonia appear in the alveoli immediately about the involved capsule, and the exudate becomes transformed into tubercles or organized into fibrous tissue, while any caseous foci become encapsulated. This process may be limited to a very small zone about the lymph node, or, if the numbers of bacilli are larger, the process gradually extends exactly as does a progressing apical lesion in the adult, with an advancing margin of pneumonia and tubercle formation, leaving behind scar tissue with embedded tubercles and encapsulated caseous foci.

Rich and McCordock have seen such a lesion which extended from the hilum almost to the pleura, forming a dense, roughly wedge-shaped area in which the lung tissue had practically been entirely replaced by the process. In principle, the advance of this form of lesion is entirely comparable to that of a progressing apical lesion in adults. Both develop under the influence of resistance, and the degree to which caseation is in evidence depends upon the balance between the numbers of organisms and the degree to which allergy is developed.

B. 1 and 2. *Rapid destruction of large areas of tissue.*—In civilized adults, with the exception of the rare individuals who escape the protective infection of childhood, rapidly progressing extensive areas of destruction of lung tissue with little evidence of repair are seen only in the case of the sudden discharge of great numbers of bacilli into the bronchi. In the child, such a lesion may result from the



rapid progressive spread of a primary pulmonary lesion initiated by large numbers of bacilli, or even by smaller numbers in the event of an unusual delay in the appearance of resistance following infection. Since various infections and metabolic disturbances are well known to depress acquired resistance greatly, the accidental presence of any of these conditions immediately following a primary infection with the tubercle bacillus must hinder the prompt and successful development of resistance, and may so favor the progressive spread of an infection caused by a number of bacilli which would have been held in check had resistance developed properly. Rich and McCordock, however, state that in their experience very extensive rapidly progressing caseating lesions in the child are most frequently the result of the discharge of quantities of bacilli into a large bronchus from an adjacent lymph node while, as stated before, cavity formation has been, in the lung of the child, more commonly the result of progression of the primary lesion.

*Tuberculous meningitis.*—The following description is based upon the experimental work and observations reported by Rich and McCordock (2). A list of the various lesions as divided by these authors, according to type is given below:

- I. Focal disseminated tubercles.
- II. Localized caseous plaques.
- III. Exudative meningitis.
  - a. Diffuse.
  - b. Localized.
- IV. Proliferative meningitis.
  - a. Diffuse.
  - b. Localized.

Diffuse exudative tuberculous meningitis is typical of the exudative-necrotic, allergic form of reaction. It is characterized, macroscopically, by the presence of a thick gelatinous exudate in the meshes of the pia-arachnoid membranes, especially about the base of the brain, with very minute cheesy nodules which are most plentiful along the course of the blood vessels. Microscopically, the characteristic features are the abundant serofibrinous and cellular exudate, the cells of which are predominantly of the mononuclear type, the infiltration of the walls of blood vessels with mononuclear cells, and the necrosis of the exudate and of the infected vessel walls. In acute cases no sign of a proliferative process may be found. Tuberculous meningitis, however, frequently runs a protracted enough course to allow proliferative and reparative attempts to become evident following the acute allergic inflammation, so that sheets of epithelioid and connective-tissue cells are often seen adjacent to the membranes, about the blood vessels, or encapsulating necrotic debris, and true nodular tubercles may also be found.

**Because of the exudative-necrotic character of the acute reaction, and because of the frequency of the association of meningitis with miliary tuberculosis, this lesion is quite generally regarded as a prompt, allergic manifestation resulting from direct heavy infection of the meninges by bacilli escaping freely from the blood stream and localizing in the meshes of the pia-arachnoid.**

Rich and McCordock, however, found that they were completely unable to produce diffuse meningitis experimentally, even when bacilli were injected directly into the carotid artery, by either single or by repeated injections of large amounts of virulent tubercle bacilli made intravascularly into either normal or allergic animals. The viscera of the originally normal animals would become riddled with tubercles, but in the central nervous system only scattered tubercles were found in the brain substance and, more rarely, in the meninges. Negative results as far as the production of diffuse exudative meningitis was concerned obtained in the case of the allergic animals. They, in common with several other investigators, however, have regularly produced quite typical exudative meningitis in rabbits and guinea pigs by injecting tubercle bacilli directly into the subarachnoid space. Blood-borne tubercle bacilli, apparently, do not lodge readily in the meninges or escape from the blood stream into the subarachnoid space, in large numbers, while the factors of high allergy plus the presence of abundant circulating bacilli are not sufficient in themselves to bring about tuberculous meningitis in these animals. On the other hand, these workers and others have seen miliary tuberculosis follow the direct experimental infection of the meninges.

The characteristic and prominent involvement of the meningeal blood vessels in exudative tuberculous meningitis has led to the belief that the bacilli, arriving by way of the blood stream, reach the meningeal spaces by penetrating the vessel walls. Against this view, according to Rich and McCordock, is the fact that careful study will show that the intimal change, or the accumulation of cells beneath the endothelium, is a later event than the adventitial infiltration. In the experimental meningitis noted above the vascular involvement was identical with that observed in human tuberculous meningitis, and there was just as marked a tendency for the process to localize in and about the walls of the vessels. They have also observed seven human cases in which meningitis was produced by the discharge of bacilli into the meninges from caseous brain or meningeal lesions without the presence of miliary tuberculosis. It was known that the route by which the bacilli reached the meninges was not by way of the blood and through the vessel walls. In all of these cases the vascular alterations were characteristic of those in

which the meningitis was supposed to have originated from blood-stream infection.

With the knowledge that tuberculous meningitis could be produced experimentally in animals by the direct injection of bacilli into the subarachnoid space, Rich and McCordock investigated autopsy material, from 40 cases of diffuse tuberculous meningitis in human beings, for local caseous lesions which could have served as foci of discharge of bacilli directly into the subarachnoid space. On careful sectioning, multiple caseous tubercles varying from several millimeters to 1 centimeter in diameter were found scattered in the brain substance in 38 of the 40 brains examined. In the two instances in which no such foci were found, the entire brain was not available for examination. Of these 40 cases with meningitis, 7 were free from generalized miliary tuberculosis, but even in these, one or more caseous tubercles were found in the brain, undoubtedly a result of the hematogenous dissemination of bacilli which always occurs in association with a progressive lesion anywhere in the body. In this connection, Rich and McCordock examined the brains from six cases of pulmonary tuberculosis without meningitis but in which disseminated tubercles were found in the abdominal viscera, and in every instance they found caseous tubercles in the substance of the brain. It would appear that these tubercles are frequent complications of progressive visceral tuberculosis.

Caseous foci in the substance of the brain constitute a potential source of discharge of bacilli directly into the subarachnoid space. It is necessary only that, in their growth, they reach the meninges without encapsulation, or else discharge into the ventricular system. Rich and McCordock found in 31 of the 40 cases previously noted, caseous tubercles, usually multiple, in the cortex extending to the surface of the brain, usually in the depths of a sulcus, and directly infecting the meninges; and in 2 cases, caseous tubercles discharged directly into the ventricles. Of the remaining 7 cases of meningitis, 2 were caused by the direct discharge of bacilli into the subarachnoid space from caseous foci in the meninges, 1 by the extension of a tuberculous process from an infected vertebra, and in 4 instances in which neither the entire brain, spinal cord, nor middle ears were available for study, discharge of bacilli directly into the subarachnoid space could not be demonstrated. Tuberculous otitis media may involve the meninges by extension of the process through the bone.

It is quite possible that bacilli may lodge in the meninges and under the proper conditions of dosage, virulence, and resistance, may proliferate and give rise to circumscribed caseous tubercles of considerable size.

The result of such an event is a sharply circumscribed caseous mass varying from several millimeters to several centimeters in diameter, situated in the meninges either on the surface of the brain or hidden within a sulcus. On the surface of the brain the mass tends to assume a plaque-like form. These caseous foci may be encapsulated and remain quiescent. If, however, they begin to spread progressively at a rate which allows the escape of bacilli into the surrounding meninges, diffuse exudative meningitis follows, beginning first in a zone immediately about the focus but rapidly spreading to involve the meninges everywhere as the bacilli discharged from the focus are distributed throughout the subarachnoid space.

One of the two cases in which caseous foci were found in the meninges was particularly interesting in that the diffuse exudative-necrotic meningitis began during the puerperium in the complete absence of miliary tuberculosis or of any other progressive lesion elsewhere in the body.

The meningitis was easily traceable to a large old caseous meningeal lesion deep in a sulcus, and clearly represented a flare-up of this old lesion during the period of lowered resistance associated with the puerperium. The caseous focus itself was undoubtedly the result of a period of bacillemia some time before, either during the childhood primary infection or during the later apical reinfections, and it is entirely comparable to the large solitary tubercles within the brain which may remain stationary in size for a long period or, increasing in size during a period of lowered resistance, give rise to pressure symptoms.

Not every brain tubercle which extends to the meninges produces diffuse exudative meningitis, as this complication depends upon whether or not bacilli are readily discharged from its margins. A tubercle in which encapsulation keeps pace with growth may reach the meninges without discharging more than an insignificant number of bacilli, which produce only a small area of meningitis immediately about the tubercle. Moreover, it is very uncommon for tubercles to reach a diameter of several centimeters before becoming encapsulated, and for this reason widespread exudative meningitis occurs rather rarely as a result of the presence of very large tubercles in the brain even when they are in contact with the meninges. The foci responsible for meningeal infection are, rather, the smaller caseous tubercles with little or no encapsulation which have their origin in the gray or white matter near the surface of the brain.

Bacilli responsible for the ependymal "tubercles" commonly observed in cases of tuberculous meningitis can reach the ventricles by retrograde transport from the subarachnoid space, although the movement of the cerebrospinal fluid is in the opposite direction. Rich and McCordock have found this ventricular infection both in animals in which they introduced "the bacilli directly into the meningeal spaces, and in the human cases in which meningitis followed the discharge of bacilli into the subarachnoid space on the surface of the brain in the absence of miliary tuberculosis. Numerous inves-

tigators have shown that inert particulate matter introduced into the subarachnoid space about the brain or the spinal cord can find its way into the ventricular cavities. The infection of the ependyma, therefore, is not to be regarded as an evidence of blood-stream dissemination of bacilli."

*Tuberculosis of serous cavities.*—What has been said regarding the meninges is probably true of serous cavities in general. The sudden, massive pleural effusion is usually attributed to an allergic manifestation following the lodging of bacilli in the pleura. Similar effusions have been produced experimentally by injecting tubercle bacilli into the pleural cavities of allergic animals. In regard to the manner in which bacilli reach the serous cavities in man, Rich and McCordock believe that it is due in each case to the rupture of a local tuberculous lesion such as "a caseous subpleural lymph node, a focus at the surface of the lung, or a cold abscess in association with vertebral tuberculosis, discharging bacilli into the pleural cavity; a caseous focus in bone or cartilage discharging into a joint; a tuberculous Fallopian tube or caseous mesenteric lymph node discharging into the peritoneal cavity; a tuberculous lymph node involving the pericardium, or a direct extension from pleural tuberculosis." Their reasons for believing this are:

(a) Massive effusions do not occur when bacilli lodge only here and there in these membranes even in the face of allergy, as witness the absence of pleural effusion in many cases of miliary tuberculosis in which the pleura is studded with tubercles; (b) massive effusions do occur when a caseous focus ruptures into a serous cavity, as we have had occasion to observe at autopsy in numerous instances; (c) we have never been able to produce a serous effusion by intravascular injection of bacilli into normal or allergic animals; (d) effusion can be produced by injection of bacilli directly into a serous cavity in an allergic animal; and (e) small numbers of bacilli, such as might enter the pleural cavity from the blood stream, if injected directly into the cavity fall to produce an appreciable effusion. Such quantities of organisms in the human being can reach a serous cavity only through the means of a local, discharging tuberculous focus. Although a minimal exudative inflammation may follow the escape of small numbers of bacilli from the blood stream of an allergic animal, since only small numbers ever do escape so at any one of the sites in question, we may state as a general principle that all of the outspoken, extensive, exudative, tuberculous inflammations (pneumonia, meningitis, effusions into serous cavities) have a common manner of origin, that is, the discharge of abundant bacilli from a near-by local tuberculous focus directly into the area in question.

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[To be continued]

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### WHAT WE KNOW OF INFLUENZA AND HOW WE MAY ADD TO OUR KNOWLEDGE<sup>1</sup>

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On previous occasions I have taken so much time and space in setting forth the scanty nature of our knowledge of influenza that any further detailed discussion of our ignorance seems unnecessary. A few topics, however, appear worthy of brief consideration.

The rapidity with which epidemic influenza travels and the large number of persons attacked within a short period gave rise to early conjecture that the disease was borne by the wind or, at least, that it was dependent on general atmospheric or even cosmic conditions which affected nearly simultaneously large masses of people. One writer asserted that "the depraved constitutions of the atmosphere are the causes of almost all epidemic distempers" (Huxham). Another called influenza "a blast from the stars." These beliefs have died hard and there are still to-day some observers who maintain that the occurrence of widespread and mysterious fluctuations in susceptibility furnish an adequate explanation for the rise of pandemics. Modern students of influenza are, however, a unit in regarding influenza as a typical infectious disease due to a living, if yet unknown, microorganism. Whatever the origin of pandemics, whatever the possible predisposing effect of obscure cosmic factors, there need be no hesitation in accepting the fact that influenza is a germ disease spread largely, if not wholly, by human agency.

The mode of transmission of influenza is necessarily inferential. There is no evidence that water or milk ever serves as a vehicle of infection or that the virus resists drying for considerable periods and is transmitted in dust. The various diseases of domestic animals denominated influenza seem to have no relation to the human infec-

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tion. The hypothesis of an insect vector appears quite fantastic. The facts that are known about the manner of spread of influenza epidemics accord best with the hypothesis that the disease passes directly from one human being to another, probably by droplet infection. While no precise information exists as to the relative importance of active cases, convalescent cases, or healthy carriers, in spreading infection, there is reason to believe that persons suffering from the disease in its early stages are particularly likely to convey the infection to others.

Since the pandemic of 1918-19 the laboratory study of the infection seems to have languished, and few bacteriological studies of importance have appeared. This would seem to be due not to any lack of material—for several extensive epidemics have occurred—but to the almost overwhelming technical difficulties involved. The remarkable quality that the influenza virus has of facilitating invasion of the body by many kinds of other microbes, the apparent insusceptibility of the ordinary domestic and laboratory animals to influenza infection, and the difficulties of securing nonimmune human volunteers and inoculating them with a freshly isolated virus during an epidemic period, are some of the factors that make the bacteriological investigation of influenza peculiarly arduous and complicated. The most recent extensive study of which I am aware is that carried out by Falk and his associates in the University of Chicago. Their results, obtained by monkey inoculations on a large scale, are in a high degree suggestive of the isolation of a definite microbe. Their conclusions must necessarily run the gauntlet of confirmation by other workers.

Much of the early uncertainty about the identity of inter-pandemic influenza has now disappeared. The careful clinical and epidemiological studies made since 1919 have left little doubt in the minds of most observers that such outbreaks as those of 1920, 1926, and 1928-29 in this country, and those of 1922, 1927, and 1928-29 in Great Britain, are definitely comparable with the great pandemics. While we must wait on substantial bacteriological knowledge for a final conclusion, we seem at the moment amply justified in the assumption that at least under modern conditions of transportation there is no break in the continuity of influenza infection in large population aggregates.

Since 1919 there have been many local flare-ups in Europe and North America, and a considerable number of fairly widespread outbreaks in addition to the notable epidemics already specified. This may be taken as support for the view that the virus of influenza is widely disseminated throughout the civilized world; that from time to time special varieties of this virus arise by unknown biological processes; and that some of these varieties become the

prime factor in the genesis of epidemics of greater or less magnitude. It may even be true that these new types of influenza virus are merely immunologic races similar to those known to occur in several familiar microbic groups, and that the advent of one of these new races in a population already fairly immunized to its own indigenous strains finds such a mass of specifically susceptible individuals that rapid epidemic spread is possible. Whether this is the explanation or not, it seems to be the case that at least in recent years influenza has not died out completely on the great continents in the periods between the pandemics. The relatively incomplete data available for 1890 to 1918 appeared to indicate this quite strongly; the observations made since 1918 bear witness that for every calendar year since the greatest of pandemics it is possible to obtain a record of the excessive prevalence of influenza somewhere in the world.

In the field of prevention little real progress has been made. It seems justifiable to increase the emphasis already placed on the influenza patient as a definite focus of infection and to adopt reasonable measures to reduce crowding and direct contact to a minimum during a period of epidemic prevalence. A stricter isolation of influenza patients will probably some day be put into effect. During the 1928 epidemic at the University of Oregon (1), stress was laid upon the early isolation of all sick persons, with the result that the morbidity was less than 15 per cent, whereas 9 of the 15 nurses employed (60 per cent) contracted influenza. The opportunities for self-protection by individuals lie along the same line—avoidance of crowds and of direct contact with influenza patients and with all persons suffering from "colds"; rigorous abstention from the use of common drinking glasses, common towels, and the like; and scrupulous hand washing before eating. While measures of personal hygiene designed to promote physical vigor and well-being are assuredly not to be decried, it is not clear that such measures are efficacious in preventing influenza infection during an epidemic period.

In the lack of any demonstrated causal agent of influenza it is plain that no valid specific vaccine is available. The so-called influenza vaccines and serums prepared with a gay assortment of organisms of conjectural importance could hardly be expected to be very effective. In point of fact their use, whenever accompanied by adequate controls, has signally failed to show any beneficial result. In a recent report by Sir George Newman, chief medical officer of the British Ministry of Health, the records of influenza incidence among the inoculated and uninoculated pupils at a large public school from 1920 to 1929 manifest in a striking way the



absence of any cogent evidence of protection. Since the immunity conferred by a natural attack of influenza is apparently slight and transient, we are, perhaps, not warranted in entertaining very high hopes of success from artificial immunization.

Among the almost innumerable problems concerning influenza that present themselves to the investigator, only a few of the more crucial can be mentioned here.

1. Interest has always been keen in the relation of influenza to the common cold. Observers have reported that during an influenza epidemic many "colds" are of the "influenzal" type, and in some instances definitely traceable to cases of "true" influenza. In a noninfluenzal period even, many observers have been struck by the similarity to influenza both of individual cases of "cold" and of small epidemics. There is obviously chance for confusion here, but if it is true, as it seems to be, that influenza never quite disappears from our great communities, it may be fairly supposed that certain more or less definite clinical and epidemiological types deserve to be included in the influenza concept.

One of the most important questions to be settled is: When is a cold a cold, and when is it influenza? The recent studies of Van Loghem (2) in Holland are thought by him to indicate an epidemiological differentiation between the illnesses in that country reported by volunteer lay observers as colds and those reported as influenza. Whereas the increase and decrease of colds in the Netherlands from September, 1925, to June, 1926, ran parallel to the fall and rise of air temperature and, in his opinion, gave no evidence of contagiousness, the reported cases of influenza followed a generally independent course and attained their maximum in March-April. Both pneumonia mortality and influenza mortality concurred with the influenza cases of the inquiry. This is interpreted by Van Loghem as indicating a rather sharp demarcation between colds—which he classes as noncontagious commensal infections founded on a disturbance of thermoregulation—and influenza, which he regards as a true parasitic infection, taking its own epidemic course. Van Loghem's data, however evaluated, should be greatly extended to elicit the true relation between colds, influenza, and pneumonia. There is obviously much to be hoped here from significant epidemiological studies such as those being carried out by Frost during interpandemic periods.

2. Attempts to identify influenza or to distinguish between influenza and colds bring up sooner or later against the time-honored problem of the clinical differentiation of influenza. That this is a hard nut to crack can not be doubted. Apparently most cases of influenza, particularly those in patients ill enough to be available

for inquiry, are complicated by secondary or concurrent infections with a variety of microorganisms, and the simple influenza symptom complex—if there be such—is consequently usually distorted or at any rate variously colored.

In other diseases clinical phenomena often fail to give clear-cut distinctions corresponding to the specificity of the attacking microbe. Even in well-known and long-studied diseases, such as typhoid and the paratyphoid infections, clinical differentiation may completely fail. When all is said, however, I am unwilling to believe that the possibilities of clinical study of influenza and colds have been exhausted. Several good observers consider the blood picture of influenza with its frequent leukopenia, its absence or nearly complete absence of eosinophils and blood platelets, and its relative lymphocytosis to be highly characteristic. In the latest epidemic the hematologic picture, where observed, was said to be strikingly uniform. Intensive clinical and laboratory study of selected cases should be of great value.

3. The significance of local variations in the prevalence and mortality of influenza offers a problem of engrossing interest. Why is it that in definite geographic areas in every great epidemic the discrepancy between the lowest and highest incidence and the lowest and highest excess mortality rates should be so great as is the case? It is stated that in last winter's outbreak in the United States, influenza first appeared in October at San Francisco, where an increase in the death rate was manifest toward the end of the month. In that city, however, the increase in deaths from influenza and pneumonia never reached a high point and the cumulative excess annual mortality rate was only 762 in 11 weeks, while in Los Angeles it aggregated 5,136 in 12 weeks. This was reversing the conditions observed in 1920, when San Francisco had a much greater excess death rate than Los Angeles. It might be tempting to cast about for an explanation of such phenomena on the basis of population immunization, were there not a considerable number of instances in which a high or a low influenza-pneumonia mortality recurs steadily in one and the same locality, epidemic after epidemic. Pittsburgh affords one of the most remarkable instances of this sort, having had the highest—or nearly the highest—rate in any American city in 1918, repeating this record again in 1920 and ranking second only to Birmingham, Ala., in 1929. The city of Sheffield, England, seems to be similarly liable to frequent and severe visitations of influenza. Of the latest epidemic (1929) the report of the British Ministry of Health says: “\* \* \* as in previous inter-pandemic outbreaks, this city (Sheffield) appeared to be a local focus of infection.”

A singular feature of local distribution is the patchy character of most of the large outbreaks; cities close to one another often show a marked difference in death rates. In 1928-29 Cincinnati and Columbus, Ohio, had considerably higher rates than Cleveland and Toledo in the northern part of the State. Dayton, however, less than 60 miles from Cincinnati, had the lowest rate of any of the five cities. In this same epidemic, also, the cumulative excess death rate (9 weeks) was more than 25 per cent greater in St. Paul than in Minneapolis.<sup>1</sup> In April, 1926, the city of Glasgow, Scotland, suffered severely from an influenza outbreak, while Edinburgh, less than 50 miles from Glasgow, was hardly affected by the epidemic and showed no rise in general death rate. It was noted in Massachusetts in the 1918 epidemic that "the incidence of the infection varied widely and for no apparent reason. \* \* \* Marlborough, surrounded by cities and towns almost overwhelmed by the outbreak, had few cases and needed no help."

Here must be mentioned, too, the change in the general character of an epidemic as it passes from one region to another. The 1928-29 epidemic in the United States, which first appeared on the Pacific coast and traveled generally eastward, seems to have lost its epidemic push as it neared the Atlantic seaboard. The death rates in New York, Boston, Philadelphia, and Baltimore were relatively little affected by the advent of the epidemic. In Germany, on the other hand, the epidemic which first appeared at Breslau about the middle of December, 1928, became much more serious as it traveled westward, the death rates in many towns in western Germany which were attacked a month later rising to twice the height of those of the towns in Brandenburg and Saxony (3). Light should be thrown on some of the problems of this nature by the epidemiological studies now in progress of Rosenau and his associates in Massachusetts and of Smillie and others in isolated communities in several well selected parts of the world.

4. One of the most striking features in interpandemic influenza is its seasonal mortality. While it is true that several of the large pandemics have originated in summer, late spring, or early autumn, the majority and especially the minor epidemics of the interpandemic periods have shown—as judged by mortality—a marked predilection for the colder months of the year. In the large cities of the United States the weekly excess mortality rate (annual basis) reached its peak in 1920 in the week ended February 14, in 1926 in the week ended March 27, and in 1929 in the week ended January 12. In England also, during the outbreaks of 1922, 1924, 1927, and 1929 the

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<sup>1</sup> It is, of course, impossible to say what proportion of the excess mortality is due to a high influenza incidence rate and what proportion to a high case fatality.

peak of influenza deaths in the large cities fell in the first three months of the year.

Continuous morbidity studies accompanied by climatic data should help to determine to what extent the seasonal exacerbation of the influenza death rate is due to an increased prevalence of the infection and to what extent to a relatively high case-fatality. Here also, detailed and sufficiently prolonged studies in isolated communities as well as in centers of population are needed for the determination of the fundamental relation between predisposition and infection. There is little doubt that our knowledge of influenza can be greatly extended by systematic epidemiological inquiry along these lines.

#### REFERENCES

1. Miller, F. N.: *Pub. Health Rep.*, 44: 1353, 1929.
2. Van Loghem, J. J.: An Epidemiological Contribution to the Knowledge of the Respiratory Diseases, *J. Hyg.*, 28; 33, 1928-29.
3. *Month. Epidemiol. Rep.*, League of Nations, March 15, 1929.

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#### A FATAL CASE OF CAISSON DISEASE FOLLOWING A DIVE OF SHORT DURATION TO A DEPTH OF THIRTY FEET

This report is based upon information furnished by Lieut. I. B. Polak, Medical Corps, United States Navy, and by Chief Gunner C. L. Tibbals, United States Navy.

A quartermaster, first class, 24 years of age, whose height was 69½ inches and weight 152 pounds, was undergoing instruction in the use of the "artificial lung" during training in submarine escape at the United States naval station, Pearl Harbor, T. H.

On the morning of May 5, 1930, after operating the "lung" successfully on the platform above water he entered the diving lock or bell which is an air-tight chamber about 3 feet deep and open at the bottom. In principle, this bell is similar to an inverted empty tumbler submerged in water. A platform is attached below the base for the occupant to stand upon; the occupant's head and shoulders, when standing upright, being above water level in the bell. Air is supplied to the interior by means of a rubber hose. As the bell sinks, sufficient air pressure is maintained to keep the water from rising inside the bell. The pressure required is equivalent to that of the depth of water from the surface to the lower edge of the bell. If, as in this case, the bell is submerged until the top is 25 feet below the surface the air pressure within would be equivalent to the pressure of 25 plus 3 feet of water or approximately 12.4 pounds excess pressure (27 pounds absolute pressure).

During the morning the bell first made two descents to depths of 7 and 15 feet, respectively. On ascents from these depths the man

did exceptionally well and his mental attitude, as stated, was "calm and cool." About 10.30 a. m. the bell was again submerged so that its lower edge was 28 feet below the surface. As stated, the excess pressure within was about 12.4 pounds. The length of time required for the descent of the bell and in the inflation of the lung by the man preparatory to emerging was approximately  $5\frac{1}{2}$  minutes. His ascent was described by Chief Gunner Tibbals as follows:

I could feel him put his leg around the ascending line and feel or follow him up to the first stop, which we have made 18 feet from the surface. Ascent to this 18-foot stop consumed approximately 20 seconds. He stopped at the 18-foot stage approximately 20 seconds. The next 9 feet in ascent were made in about 3 seconds, after which he slowed down to about 20 seconds for the remainder of the ascent.

From the 18-foot depth, he ascended the next 6 or 9 feet faster than he should and faster than the life line could be hauled in by hand. He then checked his ascent and came to the surface gradually. Upon reaching the surface, he closed the valve on the mouthpiece, removed the nose clip and swam to the landing stage. He started up the ladder but collapsed and "froze" to the ladder after taking about two steps. He was brought to the stage, placed immediately in an improvised recompression chamber and the pressure quickly raised to 17 and then to 20 pounds, or 35 pounds absolute pressure. Staying at a depth of 25 feet for less than  $6\frac{1}{2}$  minutes, counting the time taken in the ascent, should cause about a 75 per cent saturation of the blood with nitrogen or about 0.0866 c. c. of nitrogen per c. c. of blood. Recompression to 20 pounds gauge pressure was about 8 pounds in excess of the pressure experienced at a depth of 28 feet and equivalent to that at 46 feet. It was, therefore, equivalent to an excess pressure of 18 feet of water or 61 per cent over that to which the man had been subjected.

He appeared to revive after 10 minutes exposure to 20 pounds gauge pressure and stretched his arms, fingers, and legs. Upon opening his eyes, the pupils contracted. About 5 seconds later he collapsed. No radial pulse could be felt, the pupils dilated and the skin became cold, clammy, and cyanotic. This occurred about 10.45 a. m. Artificial respiration was started at once, oxygen administered, the pressure in the tank reduced, and a medical officer summoned. He arrived two minutes later. Life was apparently extinct but artificial respiration was continued without results for over an hour. About 8 ounces of blood stained fluid was discharged from the mouth when artificial respiration was first started.

At autopsy, which was performed by Lieut. Commander E. G. Hakansson, Medical Corps, United States Navy, there was no crepitation of the subcutaneous tissue and no free air in the peritoneal cavity. Stomach and intestines were essentially normal. The liver

was purplish in color. Cut sections showed considerable congestion and air escaping from the cut surface formed masses of small bubbles. The spleen, kidneys, and to a lesser extent the visceral peritoneum, were also congested. Crepitation was elicited in the mediastinal tissues as in emphysema. The bronchi contained some bloody mucus but no water. Air bubbles lifted the visceral pleura of the lungs in many places. These bubbles varied in size from 1 mm. to 10 mm. in diameter. No other pathological changes were noted in the lungs. The heart appeared to be slightly enlarged. It was firm in consistency and, on compressing the base, air bubbles could be felt passing into the aorta. Numerous air emboli could be seen in the veins on the surface of this organ and on opening the left ventricle a quantity of frothy blood escaped. The myocardium, valves, and coronary arteries were normal. There was a persistent thymus gland about 2 cm. wide, 5 cm. long, and 4 cm. thick extending over the great vessels. Fibrous tissue and some glandular tissue were found in cut sections. There was no increase in the amount of cerebrospinal fluid and no congestion of the brain. The veins of the pia contained so many air emboli that they were described as partially filled with air. Cut sections of the brain showed no hemorrhagic areas, tumor, or other gross pathology. Caisson disease was recorded as the primary cause of death and a persistent thymus as the contributory cause.

Caisson disease developing after an exposure of 5 or 6 minutes to an excess pressure of one atmosphere or two atmospheres absolute pressure is a rare occurrence. A similar case in which the patient recovered was reported on page 628 of the United States NAVAL MEDICAL BULLETIN, July, 1927. This patient, wearing a diving helmet, descended to a depth of 33 feet where he remained approximately seven minutes. He then removed the helmet and came rapidly to the surface. Symptoms appeared while he was still in the water and within a short time convulsions occurred. His condition at first was not regarded as caisson disease. Recompression to 22 pounds was resorted to about 27 hours later with no apparent benefit. He was again placed in a recompression chamber about 72 hours after he completed the dive and the pressure raised to 75 pounds excess or 90 pounds absolute for 5 minutes. His symptoms disappeared and by the time decompression had been completed he was able to walk. He was discharged to duty three days later. This man afterwards made several dives, one to a depth of 252 feet, with no untoward effects.

Death in the first case was so rapid and so unexpected that it is doubtful if immediate recompression to a much higher pressure than that employed would have prevented the fatal issue. The need of

an efficient recompression chamber where diving is being performed is obvious. It is clearly evident that in recompression in cases of caisson disease, the pressure should be raised at once to the point where symptoms are controlled even if it greatly exceeds that to which the diver was exposed. It would appear desirable to add one short decompression stage to the present tables for ascents from depths between 18 and 30 feet, depending, of course, upon the length of time the individual remained at such depths.

**AN OUTBREAK OF FOOD POISONING ON BOARD THE U. S. S. "STEWART"  
ATTRIBUTED TO FRESH BEEF**

By C. W. STELLE, Lieutenant (junior grade), Medical Corps, United States Navy

A moderately severe outbreak of food poisoning occurred on board the destroyer U. S. S. *Stewart* on the morning of November 26, 1929, while that vessel was moored to the dock at the United States Navy Yard, Olongapo, P. I. The suspected food was fresh beef which, on the preceding day, was served in the general mess in the form of roast for the noon meal and as chile con carne for the evening meal. The first patient reported for treatment about 9 a. m. and the last in the late afternoon. Of the 107 men attached to the ship 37, or 34.6 per cent, were admitted to the sick list with symptoms of poisoning which varied from mild to very severe. Practically all members of the crew ate the meals served aboard ship. No cases were noted among the officers. Their food, though obtained from the general mess, had been prepared separately.

When questioned regarding the cause of their illness, the men stated that they did not know, but thought it was due to drinking water or spoiled meat. Water from the same source had been used before the outbreak without causing symptoms of disease and was dismissed from consideration as a causative factor. No complaints of offensive odor or taste of any food served had been reported. In an attempt to discover the cause the menus for the two preceding days and for breakfast on the day of the outbreak were consulted. They were as follows:

SUNDAY, NOVEMBER 24, 1929

BREAKFAST	DINNER	SUPPER
Bananas.	Soup.	Irish stew.
Oatmeal, sugar, milk.	Roast chicken.	Spanish rice.
Fresh beef hash.	Giblet gravy.	Bread.
Catsup.	Mashed potatoes.	Jam.
Bread, butter, coffee.	Bread dressing.	Cocoa.
	Sliced fruits.	
	Bread, butter, coffee.	

## MONDAY, NOVEMBER 25, 1929

Apples.	Soup.	Chile con carne.
Plain omelet.	Roast beef.	Baked macaroni.
Fried potatoes.	Coleslaw.	Ice cream.
Bread, butter, coffee.	Mashed potatoes.	Bread.
	Brown gravy.	Applesauce.
	Bread, butter, lemonade.	Cocoa.

## TUESDAY, NOVEMBER 26, 1929

Papaya.  
Hot cakes.  
Sirup.  
Fried bacon.  
Bread, butter, coffee.

From a study of the above menus the articles of food which may be regarded with suspicion were roast beef and chili con carne served on the day before the outbreak or about 16 hours before any of the crew became ill. As the incubation period of food poisoning is usually short, from 4 to 8 hours, it can not be stated with certainty that the meat was, or contained, the causative agent. Many of the crew had eaten beef and were not affected but all of those who were attacked had eaten some of this suspected food at one of the previous meals.

When it became evident that the number affected was steadily increasing, the patients were seen by the division medical officer who had been summoned by the chief pharmacist's mate attached to the ship. The onset of symptoms was sudden. The patients first complained of cramplike pains in the abdomen and a feeling of nausea. Occipital headache, pallor, and a moderate degree of prostration were also noted. Vomiting occurred early in most cases and continued for several hours in the more severe. The vomitus, which was greenish-yellow, at first contained particles of undigested food and, later, became thin and watery. Diarrhea was present in all cases. Those most severely affected had profuse, greenish, watery stools which were very offensive. No abdominal distention was noted. Temperatures varied from normal in some cases to 102.4° F. in others. The blood pressure was not taken. At no time was any patient considered sufficiently ill to warrant transfer to hospital.

Treatment consisted of rest in bed, castor oil, and paregoric. All patients were immediately put to bed in their respective bunks except three, who were removed to cots placed on the weather deck. There are no bunks in the sick bay on board destroyers. All patients recovered. Of the 37 affected, 11 exhibited mild symptoms and were returned to duty after 1 day on the sick list. Of the remaining 26 patients, 7 had 2 sick days each, 13 had 3, and each of the 6 who



were most severely affected remained under treatment 6 days before recovery was complete.

The beef was received aboard ship at Manila, P. I., from the quartermaster depot, United States Army, on November 22, 1929, or four days before the outbreak developed. It was inspected by the officer of the deck and the chief pharmacist's mate, found to be up to the standard in quality, and pronounced fit for consumption. It was then placed on ice in the ship's refrigerator and kept there until needed. Due to the fact that this meat was the suspected food, all fresh beef remaining after the outbreak was surveyed and destroyed. Meals have since been prepared and served in the usual way. No further sickness has been noted. The ship's cook was not suffering from any infectious or communicable disease. No bacteriological examination of the suspected food, vomitus, or feces was made.

#### SUMMARY

1. An outbreak of food poisoning occurred on board the U. S. S. *Stewart*, November 26, 1929.
2. Thirty-seven men, or 34.6 per cent, of the crew of 107 men affected. Total disability, 100 sick days.
3. Beef served for dinner and supper the day before was suspected as being the causative agent.
4. All affected had eaten some of this beef.
5. No evidence of deterioration or contamination of the suspected food was noted.
6. Unusual symptoms were observed and usual treatment of rest in bed, castor oil, and paregoric sufficed in all but two or three of the most severe cases.
7. If deductions are correct as to source of infection the incubation period (16 hours) was unusually long.
8. Facilities for storage of fresh meat on board ship are adequate.
9. No bacteriological examination of the suspected food was done.
10. The suspected food was surveyed as unfit for human consumption, and no further cases have been noted.

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#### AN EXPLOSION OF GAS FROM A FUEL-OIL TANK ON BOARD THE U. S. S. "TALBOT"

An explosion occurred in the yeoman's office on board the U. S. S. *Talbot* at San Diego, Calif., about 1.46 p. m., January 20, 1930, while that vessel was in process of being recommissioned by the crew of the U. S. S. *Marcus*. Each of the three men who were at work in the office at the time of the explosion sustained severe burns of the body and two subsequently died from their injuries. All were admitted to the hospital within an hour after the accident.

A machinist's mate, second class, was using an oxyacetylene torch to weld rivets which had become loose in the deck of the office. Two other men, a gunner's mate, third class, and a seaman, second class, were in the office but were engaged in other duties. The machinist's mate had secured one rivet and was heating the second when the explosion took place, which was of sufficient force to bend forward, at a right angle, the sheet metal bulkhead between the office and the pantry and to cause the collapse of the ventilation duct running through the office and attached to the upper deck.

There was a manhole in the deck of the office leading to an oil tank containing about 6 inches of sludge located directly beneath. Steam had been turned into the tank at about 8 a. m. on the day of the accident. The manhole plate was in position but had not been secured. Gas would tend to be generated by the heating effect of the steam upon the sludge remaining in the bottom of the tank and if for any reason the steam had been turned off, which presumably it was, air would enter the tank and form an explosive mixture. Apparently, too much gas pressure was used in operating the torch.

It is believed that separation of the tube from the torch occurred as a result of increased pressure in the former, and that the hot rivet in the deck ignited the escaping acetylene. As the lighted end of the acetylene hose whipped past the manhole, it may be assumed that it, in turn, ignited the explosive mixture in the oil tank. This would account for the fact that no odor of gas was noted before while an odor of kerosene was reported as existing after the explosion, the violence of the blast, and the fact that the manhole was open after the accident.

One of the three men died from extensive multiple burns of the head, extremities, and body, about 48 hours after the explosion. Coronary thrombosis was regarded as the immediate cause. In the other fatal case, the patient received extensive burns of the face, head, abdomen, and extremities. His condition was considered satisfactory until the twelfth day after the accident, when he developed abdominal pain and died within an hour. Autopsy showed that he apparently had received a traumatic rupture of the liver with the formation, under the capsule, of a large hematoma. Rupture of the hematoma with extensive hemorrhage into the abdominal cavity was the immediate cause of death. The machinist's mate recovered and returned to duty after 95 days' treatment in hospital.

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#### HEALTH OF THE NAVY

The general admission rate, all causes, based on returns for January, February, and March, 1930, was 419 per 1,000 per annum as compared with 402, the rate for the corresponding months of 1929

The rate for all causes is 37 per cent less than for the preceding quarter. The median rate for the first quarter, as indicated by the records of the preceding five years, is 546.

The admission rate from disease was 378 per 1,000 per annum as compared with 493, the 5-year median for the corresponding three months. The admission rate from accidental injuries was 40. The median or expected rate for the corresponding quarter of the preceding five years is 51.

Acute respiratory diseases, in general, were not more prevalent than is to be expected at that season of the year. A total of 1,940 cases of these diseases was reported by shore stations in the United States during the quarter, of which 968 were notified in January. As usual, acute catarrhal fever predominated. United States naval training station, Newport, R. I., reported 295 cases; United States naval training station, Great Lakes, Ill., 349; and United States naval training station, San Diego, Calif., 318 cases. The total number of cases of catarrhal fever reported by the United States naval training station, Hampton Roads, Va., for this quarter was only 47. The incidence of influenza at any one of the shore stations in the United States is not such as to deserve special comment, the total of 289 cases being rather evenly distributed, except at the navy yard, Portsmouth, N. H., which reported 57 cases, and the naval air station, Pensacola, Fla., 55 cases.

Five cases of cerebrospinal fever, two of which died, were notified from shore stations in the United States as follows: Naval training station, Newport, R. I., 2 cases in January; marine barracks, Parris Island, 1 case (fatal) in January and 1 case in February; naval training station, San Diego, Calif., 1 case (fatal) in January. The patients in both fatal cases were recruits of a few days service and both were received at hospital in an unconscious state. The one at Parris Island died the day following admission; the one at San Diego, three days after admission. The development of the latter of these two fatal cases followed shortly after recovery from catarrhal fever and on the same day that the patient received his second injection of typhoid prophylaxis.

There appears to have been more than the expected incidence of mumps at the naval training station, Hampton Roads, as suggested by the notification of 22 cases in January, 10 in February, and 31 in March, making a total of 63 cases for the quarter, but in view of the prevalence of the disease in the neighboring communities the number is not surprising.

Four cases of scarlet fever were reported, 1 from marine barracks, Parris Island, in January; 1 from the navy yard, Boston, Mass., in February; 1 from Marine Corps base, San Diego, Calif., in February; and 1 from receiving barracks, Philadelphia, Pa., in March.

Beginning February 5, in the person of the medical officer whose particular duty it was to examine recruits received at the naval training station, Newport, R. I., there was an incidence of diphtheria at that station which, while not of epidemic character or proportion, was interesting and disturbing. A total of 21 cases was notified during the quarter, 15 in February, and 6 in March, the early cases appearing, 1 or 2, on successive days, except the 8th and 12th, up to the 17th of the month. Thereafter cases appeared less regularly. Between the 16th and 23d of February there was no admission and on the latter date the fifteenth case occurred. All personnel at the station, including civilian employees, was promptly Schick tested and those giving positive reactions were started on immunizing injections. The toxin-antitoxin was given where the least doubt existed as to susceptibility. No source of infection could be detected other than that suggested by the fact that the patient in the first case was the medical officer who regularly examined arriving recruits. It would seem unnecessary to look further. The milk supply could not be incriminated. Before the end of February all nonimmunes had received their three immunizing injections, but as it takes from two to six months for this treatment to become effective the immediate future of diphtheria at Newport can not be foretold.

The admission rate, all sources, for forces afloat was 390 per 1,000 per annum. The median for the first quarter of the preceding five years is 419. A total of 859 cases of catarrhal fever was notified from all ships for the quarter but, as this number has a considerable time and place distribution, it is not excessive. Only 10 ships had 10 or more cases and in no instance was there an extensive outbreak. Sixty-eight cases of influenza were notified for the quarter, segregated as follows: 42 in January, of which 38 were on board the U. S. S. *Pittsburgh*; 14 in February, of which 10 were aboard the U. S. S. *New Mexico*; and 12 in March divided among 9 ships. Nineteen cases of scarlet fever were reported in the following distribution: U. S. S. *Tennessee*, 8 in January and 1 in February; U. S. S. *Oklahoma*, 7 in January; U. S. S. *Williamson*, 1 in January; and U. S. S. *Case*, 2 in March. There were 2 cases of cerebrospinal fever notified, 1 in January from the U. S. S. *Palos*, on the Asiatic Station, and 1 in February from the U. S. S. *New Mexico*. The U. S. S. *Pecos* reported 2 cases of diphtheria and the U. S. S. *Denver* 1 case, all in February. One case of smallpox was reported by the U. S. S. *Nitro* in January.

**TABLE No. 1.—Summary of morbidity in the United States Navy and Marine Corps for the quarter ended March 31, 1930**

	Forces afloat	Forces ashore	Marine Corps	Entire Navy
Average strength.....	75,497	41,253	19,444	116,750
<b>All causes:</b>				
Number of admissions.....	7,353	4,865	1,987	12,218
Annual rate per 1,000.....	389.58	471.72	408.76	418.60
<b>Disease only:</b>				
Number of admissions.....	6,572	4,454	1,812	11,026
Annual rate per 1,000.....	243.20	431.87	372.76	377.76
<b>Communicable diseases, exclusive of venereal disease:</b>				
Number of admissions.....	1,971	2,148	629	4,119
Annual rate per 1,000.....	104.43	208.28	129.40	141.12
<b>Venereal disease:</b>				
Number of admissions.....	2,765	746	580	3,511
Annual rate per 1,000.....	146.50	72.33	119.32	120.29
<b>Injuries:</b>				
Number of admissions.....	769	408	174	1,177
Annual rate per 1,000.....	40.74	39.56	35.80	40.33
<b>Poisoning:</b>				
Number of admissions.....	12	3	1	15
Annual rate per 1,000.....	0.64	0.29	0.21	0.51

**TABLE No. 2.—Deaths reported, entire Navy, during the quarter ended March 31, 1930**

Primary	Secondary or contributory	Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
Average strength.....		8,761	1,925	86,118	1,190	18,254	502	116,750
CAUSE: DISEASES								
Abscess, entamebic liver..	Abscess, multiple lung..					1		1
Abscess, peritonsillar.....	Septicemia.....			1				1
Abscess, psoas, right.....	do.....			1				1
Alcoholism, acute.....	None.....			1				1
Arteriosclerosis, general..	Angina pectoris.....			1				1
Appendicitis, acute.....	Peritonitis, local, acute..			1				1
Carbuncle.....	Pneumonia, lobar.....	1						1
Carcinoma, pancreas.....	None.....			1				1
Cardiac arrhythmia auricular fibrillation.	Nephritis, acute.....			1				1
Cardiac disorder, functional.	None.....			1				1
Carcinoma, sigmoid and liver.	Abscess, retroperitoneal..	1						1
Cellulitis, nose, face and brain.	Septicemia.....			1				1
Cerebrospinal fever.....	None.....			1		1		2
Encephalitis, acute lethargic.	do.....			1				1
Influenza.....	Pneumonia, lobar.....			1				1
Leukemia.....	None.....			1				1
Malaria, benign tertian.....	Endocarditis, acute.....			1				1
Mastoiditis, acute.....	Meningitis, cerebrospinal.			1				1
Meningitis, cerebro-spinal.	Edema, lung.....			1				1
Myelitis, transverse.....	Pleurisy, serofibrinous..			1				1
Myocarditis, chronic.....	Dilatation, cardiac acute.			1				1
Do.....	Thrombosis, coronary.....	1						1
Nephritis, chronic.....	None.....			1				1
Do.....	Myocarditis, chronic.....					1		1
Otitis, media, acute.....	Meningitis, cerebrospinal.			1				1
Obstruction, intestinal, from external causes.	None.....	1						1
Pneumonia, broncho.....	Abscess, lung.....					1		1

TABLE No. 2.—Deaths reported, entire Navy, during the quarter ended March 31, 1930—Continued

Primary	Secondary or contributory	Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
CAUSE: DISEASES—continued								
Pneumonia, lobar.....	None.....			3				3
Do.....	Myocarditis, acute.....					1		1
Rheumatic fever, acute.....	Endocarditis, acute.....					1		1
Scarlet fever.....	Pneumonia, broncho.....			1				1
Septic sore throat.....	do.....			1				1
Syphilis.....	Hemorrhage, cerebral.....			1				1
Thrombosis, coronary.....	Nephritis, acute.....			1				1
Tonsillitis, chronic.....	Hemorrhage, tonsillar.....			1				1
Tuberculosis, chronic pulmonary.....	None.....			2		1		3
Do.....	Hemorrhage, pulmonary.....			2				2
Do.....	Tuberculosis, intestines.....			2				2
Tuberculosis, chronic pulmonary, acute pneumonic.....	Dilatation, cardiac.....	1						1
Tuberculosis, iliac glands, left.....	Hemorrhage, iliac vein, left.....			1				1
Ulcer, duodenum.....	Myocarditis, chronic.....					1		1
Valvular heart disease, mitral stenosis.....	Embolism, cerebral.....			1				1
Total for disease.....		5		36		1	7	49
CAUSE, INJURIES, AND POISONING								
Asphyxiation, illuminating gas.....	None.....			2				2
Burns, multiple.....	do.....	1		2		1		4
Do.....	Thrombosis, coronary artery.....			1				1
Do.....	Rupture, traumatic, liver.....			1				1
Drowning.....	None.....	2		7		1		10
Do.....	Alcoholism.....			1				1
Fracture, compound, skull.....	None.....			1				1
Do.....	Fracture, compound, tibia, fibula, and radius.....							
Do.....	Hemorrhage, intracranial.....			1				1
Do.....	Intracranial injury.....			1		1		2
Fracture, simple, skull.....	Hemorrhage, epidural.....					1		1
Do.....	Hemorrhage, intracranial.....			1				1
Fracture, simple, vertebrae.....	None.....			1				1
Do.....	Intraspinal injury.....			1				1
Fracture near joint with dislocation.....	do.....			1				1
Heat exhaustion.....	Dilatation, cardiac, acute.....			1				1
Injuries, multiple, extreme.....	None.....	1		5				6
Amphibian plane crash: Injuries, multiple, extreme.....		2						2
Landplane crash: Injuries, multiple, extreme.....	None.....					2		2
Do.....	Asphyxiation, mud.....					1		1
Do.....	Embolism, fat; fracture both legs; amputation, left leg.....			1				1

TABLE No. 2.—Deaths reported, entire Navy, during the quarter ended March 31, 1930—Continued

Primary	Secondary or contributory	Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
CAUSE, INJURIES, AND POISONING—continued								
Intracranial injury	None			2				2
Intraspinal injury	do			1				1
Wound, gunshot, face and head	do			1				1
Wound, gunshot, thorax and upper abdomen	do				1			1
Wound, gunshot, chest	do			1				1
Wound, incised, abdomen	Shock and hemorrhage			1				1
Wound penetrating brain	None					2		2
Wound, punctured, multiple (machine-gun bullets)	do			1				1
Poisoning, food bacterial toxin, bacillus aertrych.	do					1		1
Poisoning, prussic acid	do			1				1
Poisoning, potassium cyanid, acute	do	1						1
Total for injuries and poisoning		7		37	3	8		55
Grand total		12		73	4	15		104
Annual death rate per 1,000:								
All causes		5.47		3.40	13.45	3.29		3.56
Disease only		2.28		1.67	3.36	1.53		1.68
Drowning		.91		.37		.22		.38
Injuries		1.83		1.30	10.08	1.31		1.40
Poisoning		.45		.05		.22		.10

#### ADMISSIONS FOR INJURIES AND POISONING, FIRST QUARTER, 1930

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the first quarter, 1930, is based upon all Form F cards covering admissions in those months.

	Admissions, January, February, and March, 1930	Admission rate per 100,000 per annum	Admission rate per 100,000, year 1929
<b>INJURIES</b>			
Connected with work or drill	606	2,076	2,738
Occurring within command but not associated with work	400	1,370	1,818
Incurred on leave or liberty or while absent without leave	171	586	1,354
All injuries	1,177	4,032	5,910
Industrial poisoning	6	21	34
Occurring within command but not connected with work	5	17	157
Associated with leave, liberty, or absence without leave	4	14	37
Poisoning, all forms	15	52	228
Total injuries and poisoning	1,192	4,084	6,138

*Percentage relationships*

	Occurring within command				Occurring outside command: Leave, liberty, or absent without leave	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty			
	January, February, and March, 1930	Year 1929	January, February, and March, 1930	Year 1929	January, February, and March, 1930	Year 1929
Per cent of all injuries.....	51.5	46.3	34.0	30.8	14.5	22.9
Per cent of poisonings.....	40.0	14.9	33.3	68.7	26.7	16.4
Per cent of total admissions, injury, and poisoning titles.....	51.3	45.1	34.0	32.2	14.7	22.7

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction" or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from January, February, and March, 1930, reports, are worthy of notice from the standpoint of accident prevention:

*Gasoline hazards.*—A fireman, second class, received burns of the face, hands, and arms when gasoline in the bilges of a ship's motor boat became ignited by backfire of the motor. Loss of time, 1 day.

The accidental ignition of gasoline which a fireman, third class, contrary to instructions, was using to clean the crankcase of the engine in a motor boat, resulted in burns of his face, forearms, and hands. Loss of time, 8 days.

*Kerosene hazards.*—A yeoman, third class, who was on liberty at the time, used kerosene in starting a fire in a stove. He received severe burns of the body when the fluid was ignited. As a result of the injuries it became necessary to amputate his right leg. He was subsequently invalided from the service after 478 days in hospital.

*Fuel oil hazards.*—Hot fuel oil caused burns of the chest of a fireman, third class, on duty in a fireroom on board a destroyer. He neglected to ascertain the presence and security of the burner tip before turning on the oil as required by posted instructions. The burner tip was not in place. Loss of time, 8 days.

*Firearms, careless handling of.*—In direct violation of existing instructions, a private of the Marine Corps failed to remove the ammunition from the magazine of a revolver he was cleaning. He received a wound of the hand when the weapon was accidentally discharged. Loss of time, 25 days, of which 24 were spent in hospital.



*Unsafe practice—lack of eye protection.*—A small particle of metal lodged in an eye of a seaman, first class, who was chipping steel without wearing protective goggles. Loss of time, 4 days.

In another instance a seaman, second class, neglected to wear goggles while operating a power lathe. A flying particle of steel imbedded itself in his right eye. Loss of time, 5 days.

*Unsafe practice—careless disposition of objects.*—Articles carelessly left by another caused injuries to four persons. A fireman, third class, received a lacerated wound of the foot when, in descending a ladder, he stepped on a tin can. Loss of time, 10 days.

A coxswain, also in descending a ladder, stepped on a nail in a board. Injury, punctured wound of the foot. Loss of time, 6 days.

A fireman, third class, sustained an incised wound of a foot when he stepped on a razor blade carelessly left on the deck of a bath room. Loss of time, 12 days. A chief shipfitter suffered a similar experience. He received an incised wound of the heel. Loss of time, 19 days.

*Unsafe practice—cleaning machinery in motion.*—While cleaning a drill press, the machinery of which was in motion, a fireman, second class, suffered avulsion of the nail of a finger. In this instance there was no loss of time.

*Power saw—careless operation of.*—After shutting off the power, a seaman, second class, attempted to stop a saw with his hand. Injury, lacerated wound of a finger. Loss of time, 13 days.

*Meat grinders—careless operation of.*—Traumatic amputation of the end of a finger was sustained by a ship's cook, third class, when his hand slipped into a meat grinder in motion.

A ship's cook, first class, caught his hand in the machine in attempting to push meat through a grinder. Injury, lacerated wound of a finger. Loss of time, 26 days.

*Dough mixing machine—careless operation of.*—Due to his own negligence a private marine suffered a simple fracture of the right humerus when he attempted to remove dough from a mixing machine which was in motion.

*Drill press—lack of safety device.*—Due to the lack of safety device where such was indicated, a machinist's mate, second class, suffered an avulsion of the distal phalanx of a finger when, in shutting off the switch to an electric drill which he had been operating, his hand slipped and was caught between two unguarded gears. In this case there was no loss of time.

*Unsafe practice—carbon tetrachloride as cleaning fluid in a confined space.*—Two electrician's mates were poisoned from the fumes of carbon tetrachloride. They had been cleaning motors with this preparation in an engine room aboard ship during working hours

over a period of three days. Loss of time in each case, 4 days in hospital.

*Unsafe practice—mixing sulphuric acid with a bleaching solution.*—Inhalation of chlorine gas was responsible for the poisoning of three men working in a laundry aboard ship. Through a mistake, they poured sulphuric acid into a solution of bleaching powder. Loss of time in each case, 1 day.

*Unsafe practice—precarious article of support.*—The supporting structure of a washbasin on which a seaman, second class, was standing in order to reach an object, gave way under his weight. In falling he sustained a lacerated wound of a leg and foot. Loss of time, 15 days.

#### STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by naval training stations:

##### *Cumulative data*

	Number	Per cent of recruits received	Per cent of recruits reviewed
<i>Jan. 1 to Dec. 31, 1929</i>			
All naval training stations:			
Recruits received during the period.....	13,531		
Recruits appearing before board of medical survey.....	709	5.24	
Recruits recommended for discharge from the service.....	323	2.39	45.56
<i>January, February, and March, 1930</i>			
United States naval training station, Hampton Roads, Va.:			
Recruits received during the period.....	563		
Recruits appearing before board of medical survey.....	45	7.99	
Recruits recommended for discharge from the service.....	15	2.66	33.33
United States naval training station, Great Lakes, Ill.:			
Recruits received during the period.....	870		
Recruits appearing before board of medical survey.....	142	16.32	
Recruits recommended for discharge from the service.....	72	8.28	50.70
United States naval training station, San Diego, Calif.:			
Recruits received during the period.....	1,036		
Recruits appearing before board of medical survey.....	17	16.41	
Recruits recommended for discharge from the service.....	17	16.41	100.00
United States naval training station, Newport, R. I.:			
Recruits received during the period.....	639		
Recruits appearing before board of medical survey.....	165	25.82	
Recruits recommended for discharge from the service.....	36	5.63	21.82

The following cases, selected from reports of medical survey recently received by the bureau, are presented to indicate conditions existing prior to enlistment which led to early separation from the service. These conditions were so evident that the men should have been rejected at their respective recruiting stations.

*Myopia.*—Enlisted at Baltimore, Md., March 12, 1930. History of injury to right eye through explosion of dynamite three years

prior to enlistment. V. O. D. 8/20; V. O. S. 20/20. Surveyed March 15, 1930.

*Strabismus*.—Enlisted at Buffalo, N. Y., April 1, 1930. Upon arrival at a naval training station, examination revealed a noticeable converging strabismus, associated with a marked hesitancy in color perception for both red and green. The subject also had flat feet. Surveyed April 4, 1930.

*Dental defects*.—Enlisted at Nashville, Tenn., March 20, 1930. Nos. 3, 13, 14, 20, and 30, missing or impacted; Nos. 2, 4, 5, 8, 12, 15, 16, 18, 19, 21, 31 and 32 carious. Exodontia indicated in No. 15; probable pulp involvement in others. Teeth generally unsound. Surveyed March 22, 1930.

Enlisted at Chicago, Ill., April 2, 1930. Numbers 2, 3, 5, 8, 9, 10, 11, 12, 14, 15, 17, 19, 20, 30, 31, and 32, carious. Exodontia indicated in Numbers 3, 7, 19, and 30. Probable pulp involvement in others. Teeth generally unsound. Surveyed April 4, 1930.

*Otitis, media, chronic*.—Enlisted at Nashville, Tenn., March 26, 1930. Upon examination after arrival at a naval training station, left ear was discharging pus. This condition had existed for two years. Surveyed March 28, 1930.

*Otitis media, chronic*.—Enlisted at Omaha, Nebr., March 4, 1930. Examination at a naval-training station revealed a large perforation in the left drum and marked inflammation of the right drum. Hearing was markedly impaired in both ears ( $\frac{1}{15}$  left side;  $\frac{1}{15}$  right side). It was learned from the recruit that he had suffered from "ear trouble" for the past five years and, on two occasions, had received treatment at a hospital. Surveyed March 13, 1930.

*Perforated nasal septum*.—Enlisted at Los Angeles, Calif., April 3, 1930. There was marked external deformity of the nose, resulting from an old fracture, with a large perforation of the septum and extensive adhesions between the septum and lateral walls, causing nasal obstruction. Surveyed April 8, 1930.

*Organic heart disease*.—Enlisted at Indianapolis, Ind., March 14, 1930. This recruit was found to have a systolic mitral murmur, transmitted to the left axilla. Surveyed March 15, 1930.

Enlisted at Wilkes-Barre, Pa., April 3, 1930. Examination revealed a loud blowing mitral systolic murmur, transmitted to left axilla, and slight enlargement of the heart. Recruit complained of shortness of breath on mild exertion. The tonsils were enlarged and infected. Surveyed April 8, 1930.

*Tachycardia*.—Enlisted at Cincinnati, Ohio, March 25, 1930. This recruit was found to have a constantly rapid pulse, 150, increased to 180 after exercise and accompanied by marked cyanosis of the hands. Definite tremor of the fingers was also noted. Surveyed March 27, 1930.

*Hypertthyroidism.*—Enlisted at Indianapolis, Ind., April 1, 1930. This recruit had enlargement of the thyroid gland, tremors of the fingers, a systolic murmur, transmitted to the left axilla, and rapid heart action. The rate at rest was 130, increased to 170 after exercise. He was also 14 pounds underweight. Surveyed April 2, 1930.

*Constitutional inferiority.*—Enlisted at Providence, R. I., April 15, 1930. Examination disclosed a poorly developed recruit of moron type with flat, phthisical chest, moderate kyphosis, depressed arches, and diminutive testicles. Surveyed April 21, 1930.

*Defective physical development.*—Enlisted at Pittsburgh, Pa., May 5, 1930. Reexamination of the recruit at a naval training station revealed a youth of 15 years of age (according to his statement and his appearance), weighing 112 pounds and of generally poor physical development. The condition of his mouth indicated neglect of hygienic attention. The following dental defects were noted: Nos. 1, 16, 17, and 32 were either missing or impacted; Nos. 3, 5, 14, 19, and 31 were carious. Exodontia was indicated in numbers 14 and 19. There was also a lack of requisite serviceable molar occlusion.

*Chronic nephritis.*—Enlisted at Seattle, Wash., March 14, 1930. Routine examination of this recruit upon his arrival at a naval training station revealed the presence of albumin, pus cells and casts in his urine. Daily urinalysis over a period of 10 days showed no change in this finding. He stated that his urine was not examined at the recruiting station. Surveyed March 28, 1930.

Enlisted at Seattle, Wash., March 4, 1930. This recruit was found to have a marked albuminuria with granular casts, blood cells, and pus cells. He was kept under observation from March 7, and daily urinalysis showed no change. Examination also disclosed the following additional defects: Stricture at the distal end of the urethra, the result of an operation for hypospadias; a discharging sinus at the site of a varicocele operation, with a swollen and tender testicle; and a mucous discharge from the urethra which contained Gram negative intracellular diplococci. Surveyed March 20, 1930.

*Cicatrix of skin.*—Enlisted at Nashville, Tenn., April 8, 1930. This recruit was found to have a large painful cicatrix of the left chest wall caused by an old gunshot wound. An X ray of the chest revealed 24 shot buried in the soft tissues over the ninth rib. The following additional defects were noted: Depressed arches and marked deviation of the nasal septum to the left. Surveyed April 15, 1930.

Enlisted at Raleigh, N. C., February 3, 1930. The recruit gave a history of having cut his left foot on a hoe seven years before enlistment, the wound involving plantar fascia, muscles, tendons, and

nerves. The scar extends from the head of the second metatarsal on the plantar surface, inwards, backwards, and upwards to the base of the first metatarsal on the inner side of the foot, a distance of about 6 inches. The scar is tender and obviously involves deep structures. The anterior metatarsal arch is depressed, due probably to injury to plantar musculature, and painful. There is some disturbance of sensation about the first and second toes. Surveyed March 25, 1930.

*New growth.*—Enlisted at Kansas City, Mo., April 10, 1930. A marked deformity of the left leg just above the ankle proved upon X ray to be due to a large osteoma. This growth was on the external aspect of the lower end of the left tibia and there was a deformity of the left fibula directly opposite. There is also a large scar in the left parietal region overlying a trephine opening about 1 inch in diameter in the left parietal bone. The recruit gives a history of fracture of the left fibula in 1922 and fracture of the skull in 1926. Surveyed April 29, 1930.

*Ankylosis.*—Enlisted at Kansas City, Mo., March 19, 1930. Routine examination of this recruit after arrival at a naval training station disclosed an ankylosis of the right ankle joint, as a result of an old injury. Motion was limited to slight flexion and extension. He walked with a limp. After one day of ordinary duty the ankle became swollen and painful. Chronic nephritis was an additional defect in this recruit. Surveyed March 28, 1930.

*Flat feet.*—Enlisted at Pittsburgh, Pa., April 1, 1930. This recruit had marked depression of the arches of both feet associated with callosities of both great toes and overriding of both little toes. Surveyed April 4, 1930.

*Varicocele.*—Enlisted at San Francisco, Calif., April 19, 1930. This recruit had an enormous left varicocele. The left side of the scrotum measured 7 inches in length and corrective operation was refused. There was also evidence of an old gonorrhoea. Surveyed April 28, 1930.



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