ASSOCIATE COMMITTEE ON ARMY MEDICAL RESEARCH

NATIONAL RESEARCH COUNCIL OF CANADA

ROYAL CANADIAN ARMY MEDICAL CORPS

H. V. Cone.

MEDICAL RESEARCH AND DEVELOPMENT IN THE CANADIAN ARMY DURING WORLD WAR II

1942 - 1946

"How, then, will the man who takes up a shield or other implement of war become a good fighter in a day?" Plato's Republic.

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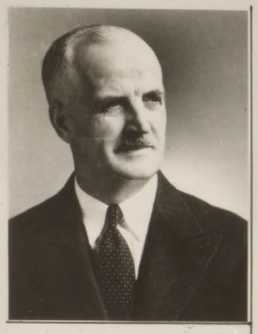
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Not included in photograph: Maj. N.E. McKinnon, Col. D.L. MacLean, Prof. D. Graham and Lt. Col. J.L. Blaisdell (Hon. Sec'y)

ARMY MEDICAL RESEARCH IN WORLD WAR II.

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ARMY MEDICAL RESEARCH IN WORLD WAR II

ORGANIZATION

(1) A.M.D. 8. Research and Development Branch of D.G.M.S.

The Research and Development Branch of the Directorate General of Medical Services was a late thought in the War. The Royal Canadian Navy and the Royal Canadian Air Force had early organized large programmes of Medical Research under the stimulus of the late Sir Frederick Banting, but no such effort had been made on the part of the Army and the activities at Headquarters were looked upon largely as administrative.

With the appointment of Major-General G.B. Chisholm, as D.G.M.S. in the autumn of 1942 and with the stimulus of Brigadier J.C. Meakins, who came into the Army as Deputy Director General of Medical Services, to supervise professional matters, an organization for medical research was set up. This organization proved itself to be peculiarly suited to the Army's needs, and since it was built to provide flexibility, a brief description is in order.

Colonel W. Hurst Brown, who had Commanded the very successful ration trials at Penobsquis, N.B., organized a new Medical Sub-directorate, A.M.D. 10 (Later A.M.D. 8) with Lt. Col. D.S. McEachern as D.A.D.M.S. Capt. E.O. Hughes was appointed executive officer and did able administrative work. A.M.D. 8 operated for a long time without any establishment, but later a hand-tailored one was authorized to meet its needs, (Appendix "A"). This consisted of a small Headquarters staff of officers and secretarial personnel. Their job was to administer projects carried out in the field and to employ and drive through, within the Army, conclusions arising out of field projects.

A major part of the establishment was devoted to a field assignment section which had vacancies for 30 other ranks. The large number of vacancies for N.C.O.'s qualifying for Trades Pay is worthy of note. It had been foreseen that personnel for research projects would have to be highly skilled technicians, or even university graduates and that they would often have to direct other men. This proved to be the case and it was most fortunate that there were suitable vacancies and tradespay to cover the needs. The deployment of this staff at one active period is shown at Appendix "AA".

The functions of A.M.D. 8 were conceived as follows: To collect and distribute medical intelligence and documents from all over the world. To advise the D.G.M.S. on new developments in medicine. To stimulate research and development in Army hospitals and medical installations. To enlist the aid of Canadian Medical Schools and other civilian agencies in solving military medical problems, and to arrange administrative details of such projects. To carry out field trials or to supply medical observers for field trials carried out by other branches of the service. To keep the Army up-to-date on medical happenings. The organization chart of these activities will be found at Appendix "B".

2. Associate Committee on Army Medical Research of the N.R.C.

When the organization was set up, a new Associate Committee on Army Medical Research of the National Research Council was also formed with the approval of Dean C.J. Mackenzie, Acting President. This was a sister committee to the three other Associate Medical Committees, which served, respectively, the Navy, R.C.A.F., and civilian profession. The organization chart of the Army Committee is given in Appendix "C".

Colonel W. Hurst Brown was Chairman of the Army Medical Committee from its inception, and Lt. Col. D.S. McEachern later became a member. This linkage meant that the two individuals mainly responsible for implementing the work of the Committee in the Army had a definite connection with the

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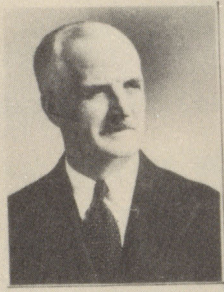
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National Research Council. This feature was envied by many in the United Kingdom and the United States, where such a bridge did not exist between civilian scientists and the Research Committee on the one hand, and the armed services, on the other. At Appendix "D" will be found the composition of the Original Committee, along with the names of the later members.

The Committee consisted of distinguished scientists from civilian life, as well as Army Personnel. It acted as trustee for the $100,000.00 yearly, which was raised by D.G.M.S. through the Army Technical Development Board.

Administration of the Committee's affairs, including the publication of Proceedings, and liaison with other medical research committees, was entrusted to Mr. S.J. Cook, Executive Secretary of the National Research Council Medical Research Committees. Mrs. M.E. Parker of the N.R.C. also helped greatly to nurture the activities of the Army group.

The Committee passed upon all applications for grants-in-aid. Many of these grants supported projects within the Army which were sponsored by A.M.D.8. In these cases funds were required only for special apparatus and equipment which were not available through regular Army channels. Army personnel were used on these projects, but the officers and men were only employed on the strength of A.M.D.8 until their project was complete. They were then released to the re-inforcement stream.

This permitted the use of men with special skills who could be released when the special need was over. In all, 92 officers and 59 other ranks served at some time on A.M.D.8 projects. A large percentage of these saw service outside Canada. Still others were borrowed for a time and later returned to their postings in Canada. The names of all these officers and experience the difficulty of seeing and manoeuvreing in the dark.

The Army's preoccupation with this problem arose from the stimulus of Major General G.B. Chisholm, upon his appointment as D.G.M.S. in the fall of 1942. During the first world war General Chisholm had served as scout for his infantry battalion. His experience impressed him with the cat-like ability of some men to carry out night sorties without endangering themselves or their fellows. He noted that the difference in performance was not always a result of awkwardness or lack of intelligence, but seemed also to depend on the varying ability of men to see in the dark.

In November 1942, Col. Hurst Brown and Lt. Col. D.S. McEachern were commissioned by D.G.M.S. to proceed to the U.S. Navy submarine base at New London, Conn., to discuss night vision problems with the National Research Council (U.S.A.) Vision Committee. They saw at once that night vision training was just as important as the grading of night vision and that, in any event, the two could not be divorced. They proposed that an attempt be made to devise a method which would include both night vision training and a simple and satisfactory night vision test.

Some of the problems of night vision work are peculiar. They have to be experienced to be really understood. Men have to be taught how to use their eyes in the dark. It is not possible otherwise to test their night vision with any validity. Further, their eyes have to become adapted to darkness before they can give proper performance in the test. This requires forty-five minutes in complete darkness. It brings up the problem of maintaining interest and discipline in a group of men in pitch-black surroundings. It would be desirable to have a group test that would permit large numbers of men to be graded at one time. The difficulty of properly recording answers

Night Vision – (1) Officers taking instruction in special dark room.

in the dark and other factors however, force the use of individual tests. Finally, because of the peculiar characteristics of night vision, it is necessary to give many brief presentations of the test object or a smaller number of presentations each of long duration. In either case, to get around the factors of waxing and waning of night vision, guessing and chance, it requires about 5-8 minutes, to carry out a single test.

With the co-operation of the Associate Committee on Aviation Medical Research, an arrangement was made whereby Lt. Col. D.S. McEachern was to work in collaboration with W/C K. Evelyn and S/L A. Elliott, R.C.A.F., who had begun some night vision studies at McGill University. The object was to develop a training and testing method for Army use. Two medical officers, Maj. B.D.B. Layton and Capt. C.R. Bourgeois joined the group later. These workers had the happy benefit of advice from Professor E.G. Burr, McGill University, a brilliant inventor and electrical engineer, who had been working for years on night vision problems. His ideas and experience provided the background for the entire development. In addition he generously provided his large dark-room in the Engineering Building, McGill University, for the work of the group.

Out of this was evolved a unique system of night vision training and testing. Evelyn designed a simple projector box, by means of which a landscape silhouette with buildings, trees, military vehicles, etc., could be projected on a white screen under dim illumination. This could be varied to simulate anything from heavy overcast to bright moonlight. A forty-five minute lecture-quiz was devised for classes up to 16 men. During this time the various features of night vision were not only described and demonstrated, but were experienced by the group. This demonstration not only taught the men how to use their night eyes, but it filled in the period of dark adaptation necessary before any test of night vision could be carried out.

The Canadian Army Night Vision Test was devised by Prof. E.G. Burr. It required a man to locate the presence of a black disk on a white background. The main principle of the test was to make the task as simple and as nearly akin to the field problem of scanning the horizon, as possible. The men were tested individually in two separate rooms, by C.W.A.C. technicians. Sixteen men could be tested per hour, whilst another 16 were receiving instruction and dark-adapting in the demonstration room. With a continuous change of men every hour, 128 could be tested during an 8-hour day by one unit. Early in 1943, through the co-operation of Col. R.H. McGibbon, D.M.O., M.D. 4, in whose district many projects were carried out, 300 soldiers were run through the test and the method was found to be satisfactory. A light-proof unit was then hastily constructed in Ottawa and the method was demonstrated before the Chief of General Staff and other high-ranking officers at N.D.H.Q. in the spring of 1943. It was enthusiastically received. The method was adopted and the decision was made to test all men on induction into the Army and all reinforcements proceeding overseas.

At this stage, the project was turned over to A.M.D.1, under Major R. Wiseman, for administration. All the development work and manufacturing of equipment had been completed. Forty projection boxes and 65 sets of testing equipment, to the value of $10,000.00 were ready, having been built for A.M.D. 8 by Major A.J. Cipriani, in the Montreal Neurological Institute. The apparatus was built under a grant from the Associate Committee on Army Medical Research, in anticipation of the Army's acceptance of the method. Thus, sufficient equipment was at hand to meet the needs in Canada and Overseas and much valuable time was saved.

NIGHT VISION TEST PANEL (BELOW). SGT. HOLWAY IS ADJUSTING ILLIMINATION TO STANDARD LEVEL BY MEANS OF SPECIAL PHOTO-ELECTRIC CALIBRATOR (ABOVE).

New buildings were constructed, or existing accommodation was altered, to provide dark rooms at each District Depot throughout the Country and at several large military camps. This ambitious programme was soon in operation and thousands were being tested per week. A special team was sent to Shilo to test the entire No. 1 Canadian Paratroop Battalion, before its departure for overseas.

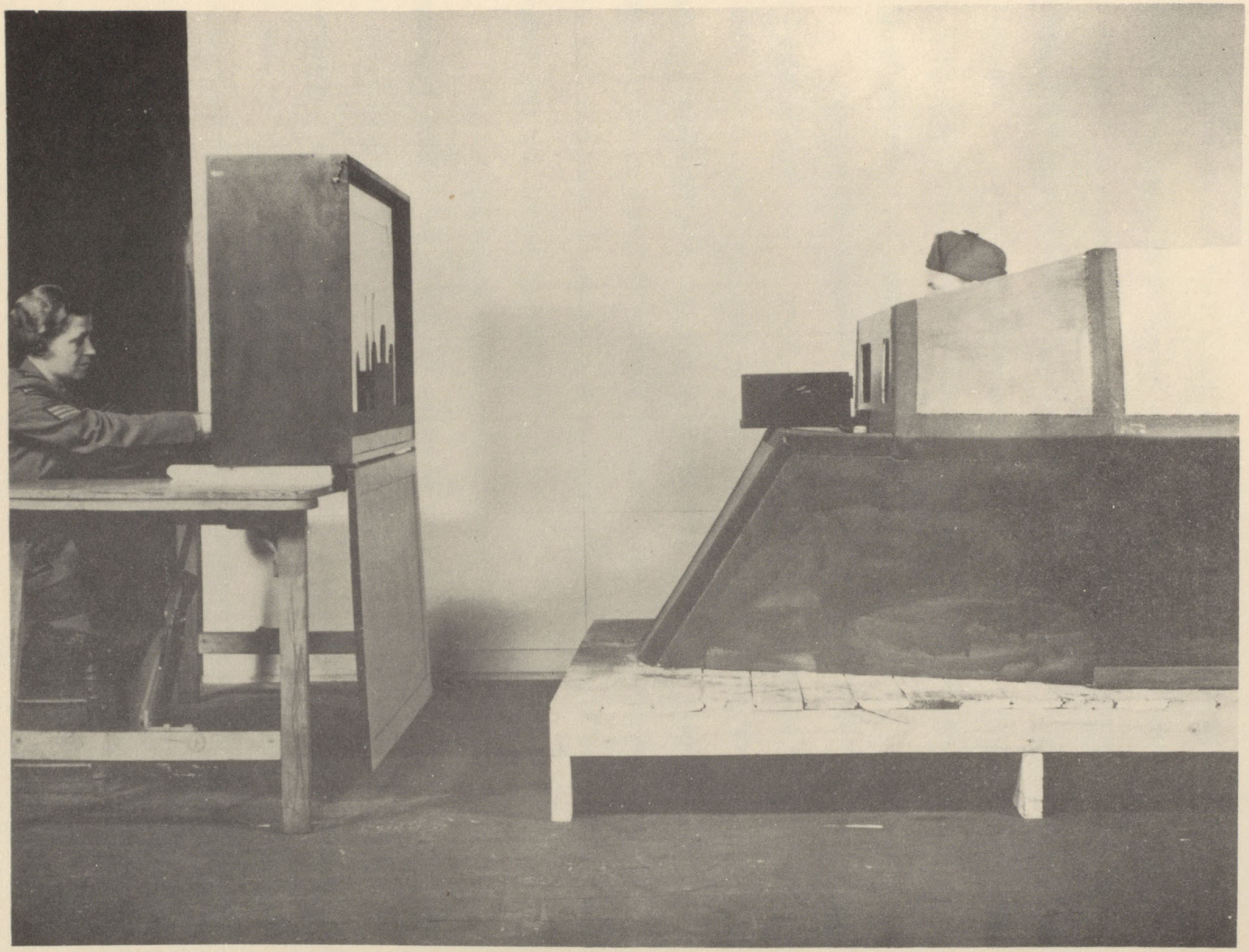
In the summer of 1943, Lt. Col. D.S. McEachern was sent to England to demonstrate the method to the Canadian Army Overseas. Space at No. 1 C.R.U., Aldershot, was altered by Army engineers, and night vision equipment, ventilating fans, etc., were installed. In October, a special demonstration was given for high-ranking officers, including representatives of the British War Office and the American Embassy. The method was again received enthusiastically and was adopted by the Canadian Army Overseas. The training features were also adoped by the War Office, upon the recommendation of Brigadier Sir Stewart Duke-Elder, Consultant Ophthalmologist.

Major Morley J. Tuttle, R.C.A.M.C., gave invaluable assistance during this period, and later, along with Capt. W.J.W. Smith, R.C.E., took over the organization of the entire night-vision programme overseas. Mobile units were equipped with special blackout tents and sent out to the field. By D-Day of the Normandy invasion, a large proportion of key personnel in the Canadian Army had received instruction and had been graded as to their night vision.

It must be apparent from this description of the Canadian Army Method that it was equally a training and a medical selection procedure, and that the two features could not be separated. This was the cause of endless debate in Canada, where the Directorate of Military Training consistently refused to take over the programme. It was therefore administered entirely by the Medical Services, with obvious handicaps. Overseas, on the other hand, the programme was taken up by Military training, with the Medicals acting in a consultive capacity. There is little doubt that the latter organization was the smoother and more successful of the two.

The test divided men into four groups as regards night vision: Excellent (10%); good (40%); fair (40%); poor (10%). These grades were entered in the soldier's paybook and other documents. They did not alter a man's Medical Category, and were really meant for the guidance of the platoon or section leader. He could use them as he saw fit in allocating men to their jobs on night patrol, etc. How much use was actually made of these grades in the field cannot yet be stated. Information on this point was being collected by means of a questionnaire at the time the war ended.

The original conception was that the testing procedure should be set up at induction centres, and the results later used for allocation. This never did work out well. For instance, by 1944 most men involved were already in the Army and had been allocated and trained. Another difficulty was illustrated by the case of Armoured Corps vehicle drivers. Here the various weeding procedures, such as "M" Test, etc., had already reduced the flow of suitable men to such an extent that the addition of another grading, such as Night Vision, left too few men who could qualify. Any future employment of night vision grading, if used for allocation, should be instituted at the very beginning and woven into the system of personnel selection and job allocation. If it is not to be used for primary allocation, grading should be done during advanced training for reasons of economy. Definite instructions should be laid down in Army Orders for the use to be made of the grade by Commanding Officers.



NIGHT VISION - (2) MOCK-UP OF ARMY SCOUT CAR TO TEST INTERIOR ILLUMINATION.

It is hard to impress some officers with the importance of night vision. Those who are most alert to it are the high-ranking officers and those who have had a large amount of field experience. Curiously enough, many people with grossly defective night vision are not aware of the fact and are, therefore, potentially dangerous to others. This is especially true if they are in command of troops, or driving a vehicle. Poor night vision in a tank driver may result in the loss of several lives, and $100,000.00 worth of equipment, at one crack.

Despite the arguments that still centre about night vision tests, the Canadian Army can be proud of its programme of training and testing. In this field Canada was well in advance of other nations when it came to practical applications, and her soldiers were given the benefit of the best that could be provided in the way of night vision training and selection. This fact has been recognized and remarked upon by authorities in the United Kingdom and the United States.

Out of the night vision work a number of important problems emerged. Commanders of Coastal Artillery began to realize that illumination of their gun emplacements was faulty. D.G.M.S. was asked, therefore, to suggest improvements. Maj. A.J. Cipriani, R.C.A.M.C., inspected Coastal Artillery units and made an extensive report, with suggestions for better illumination. He was also asked to re-design the interior illumination of the Army Scout Car, which had been very poor from the standpoint of night vision. A mock-up of the scout car was built in the Ottawa darkroom, and satisfactory illumination was designed to protect the driver's and gunner's night vision. To preserve accurate calibration of testing units throughout Canada and the United Kingdom, a special photo-electric calibrator was designed by Maj. Cipriani and used with great success in Canada and overseas. Numerous other studies on night vision problems were published in the Proceedings of the Associate Committee on Army Medical Research.

2. Evacuation of Casualties from the Field

Any method of removing a casualty from the battle field, without exposure of four able-bodied stretcher bearers to fire, would be an improvement. Various modifications of the present system had been thought of. Some of these were crystallized in the work of H/Capt. E.B. Archibald, which came to the attention of the Research Division early in 1943. Capt. Archibald of the Auxiliary Services, was a woodsman with long experience in northern Ontario, where he ran a summer camp for boys. Experience had convinced him of the ease and efficiency by which loads could be carried with the tump-line. This, in its simplest form, consists of a strap to go over the crown of the head, the tapering ends of which can be attached to the load. This primitive method of carriage has been used for decades by trappers and voyageurs in Canada, and some of the claims of loads carried are fit for the pages of Ripley.

During the first World War, Capt. Archibald personally evacuated many casualties from winding trenches single-headed by this method and doubtless saved many lives. His work so impressed staff officers, that tump-line companies were set up for the carriage of ammunition and supplies. These were organized by Major (later Major-General) F.R. Phalan, C.B., D.S.O., M.C., V.D. who has written of his experiences in the Canadian Infantry Journal.

The Research Division called Capt. Archibald to Ottawa in October of 1943. There he personally demonstrated the use of the tump-line for carrying a wide variety of military loads. He also demonstrated a stretcher

Tumpline - (1) Single Man Stretcher-carry.

Tumpline-stretcher Development - (2) Flotation Device.

sled for one-man-carry of casualties. Although all those present recognized the value of the method, nothing further was done about it. In May of that year, Archibald's stretcher equipment had been sent by A.M.D.8 to No. 28 Field Ambulance, R.C.A.M.C., at Nanaimo, B.C. There, field tests were carried out under the direction of Lt. Col. F. Hartley Smith, Officer Commanding. These indicated that the special stretcher equipment was not necessary, but that the tump-line was a valuable bit of accessory equipment when used with the General Service Stretcher. A further demonstration at Lester's Field Military Hospital, Newfoundland, in September 1943, brought favourable comment from medical officers and the Commander, Area Headquarters. During the following winter Capt. Archibald made a tour of Western Canada, under the auspices of the Directorate of Operational Research, and again favourable comment resulted. Early in 1944 Capt. Archibald was again brought to Ottawa. It was apparent, that although the tump-line idea met favour everywhere, nothing was being achieved as regards its adoption by the Army. It was decided by A.M.D.8, therefore, to send Capt. Archibald to A.22 Training Centre, R.C.A.M.C., Camp Borden, to:

(a) Develop new types of stretcher equipment for one-man-carry.

(b) Train men and stimulate the interest of instructors so that a submission could be put up for adoption of the method by the Medical Corps.

It was hoped that this would be the thin edge of the wedge. The project was financed by the Associate Committee on Army Medical Research. The Commandant, Colonel C.V. Ward, R.C.A.M.C., soon became enthusiastic, as did his instructors. A team was trained in June 1944 and a submission was put up for adoption of the method. None of the special designs of stretcher were recommended for general use but the Archibald general utility backboard with its headstrap and with slings to receive stretcher handles was found to afford a practicable and easy two-man-carry. Scale of issue for A.22 T.C., for training purposes was recommended and later adopted.

In June 1944 a demonstration of various methods of stretcher carry was given in High Park, Toronto, before many staff officers of the three services, and members of the Canadian Medical Association. This clearly indicated the superiority of the tump-line method over conventional methods of stretcher carry. Indeed one man alone or a team of two men using this method easily out-distanced four men carrying a casualty by the usual method.

D.G.M.S., with the aid of the National Film Board, also undertook to produce a film illustrating the tump-principle of carrying loads and its many Army applications. Most of the scenes were laid at Camp Borden and in the north woods. This film "Use your Head" was shown to senior officers at N.D.H.Q. in the late summer of 1944, and copies were then despatched to many of the Allied Nations. Production of this film was the final selling point and the method was shortly adopted in principle by the Canadian Army. In the spring of 1945, the Directorate of Staff Duties (Weapons) carried out extensive unit trials of packboard and tump-line equipment in order to determine the proper scale of issue for various units. When the war ended, however, the matter was still in the paper stage and the method had not even been put to as much practical use as during the 1st World War, which had ended 27 years before.

The thing that one despairs of getting across is that use of the tump-line is based on a principle; it is not merely a gadget. The reason that heavy loads are carried more efficiently in this way is that the weight is

Tumpline and Backboard for Carriage of Military Loads.

directed straight down the vertebral column and legs and is, therefore, born by the bony skeleton and not by the muscles. The muscles, including those of the neck, act merely to balance the load. When loads are carried in the arms or in the hands, or from the shoulders, a good deal of muscular effort is necessary. How often are the lessons of yesteryear forgotten.

3. Bacteriostatic Fabrics

In 1943 Mr. C.H. Bayley, National Research Council, drew to the attention of the Research Division a number of commercial preparations which were claimed to render fabrics bacteriostatic. The principal interest in the past has been in the fungicidal properties of these compounds. Some had been used extensively to treat fabrics against mildew and rot. The bacteriostatic properties and, therefore, the medical implications had been almost entirely neglected except in commercial advertisements and in the reports of commercial testing laboratories.

The following possible applications of these substances were envisaged by officers of A.M.D.8:

(i) The treatment of blankets and barrack room floors to reduce airborne respiratory disease due to bacteria-laden dust.

(ii) The treatment of personal clothing to reduce wound infection due to soiled fabric being carried into the wound along with the missile.

(iii) Treatment of personal clothing to reduce louse infestation, if the substance could be shown to be lousicidal.

(iv) Direct application to infected wounds or to surgeons' hands as part of pre-operative preparation. This would depend upon the substance being non-toxic.

(v) Treatment of surgical dressings to prevent infection spreading into the wound from outside, or conversely to prevent bacteria spreading to the surface of the bandage from the wound itself.

Samples of fabric were impregnated with one of the commercial preparations called "Perm-Aseptic." These fabrics were tested by Messrs. Gibbard and Naubert of the Department of Pensions and National Health Laboratory of Hygiene. Surprisingly enough marked bactericidal powers were demonstrated against a number of aerobic organisms in vitro. It was found that this activity was lost only slowly after repeated laundering, and scarcely at all after dry cleaning. It was decided, therefore, to study these interesting substances further and to try out a few possible applications.

At Camp Borden, Col. F.P. Lloyd, R.C.A.M.C., Senior Medical Officer of the Camp, agreed to make a large scale trial of Perm-Aseptic-treated blankets for the control of respiratory infections. A splendid organization for the determination of respiratory disease rates was set up by Col. Lloyd, with personnel carried by the Research Division. Five thousand men were divided into two groups, an experimental and a control group of 2500 men each. Col. Lloyd's detailed account of the recording machinery, which took the full time of nine C.Q.M.S's., is to be found in the Proceedings of the Associate Committee on Army Medical Research. It should be read by anyone comtemplating similar large scale trials.

Arrangements were made through Ordnance for the laundering of 25,000 Army blankets in Toronto. Half of these were treated with Perm Aseptic and the other half were used as controls. They were identified by specially applied letters, either "A" or "B". After extensive trial it was found that there was no reduction of respiratory disease and the experiment was, therefore, abandoned.

Studies on infected wounds were, however, continued by Dr. Armand Frappier, and Mr. Paul Marois, at the Institut de Microbiologie et d'Hygiene de l'Universitie de Montreal, University of Montreal. Fabrics treated with a number of different commercial substances were implanted in wounds in experimental animals along with various anaerobes. The progress of infection and lethal rate were compared with similar wounds in which non-treated fabrics were used. These authors reported very promising results. On the other hand, Capt. R. Friedman, working under Mr. Gibbard, at the D.P.N.H. Laboratory, along somewhat similar lines was unable to get favourable results. Further work reported to the Committee dealt with the skin reactions in human volunteers when exposed to patch tests with a number of these substances.

There was considerable debate from the beginning as to whether work on Perm-Aseptic should be continued or whether such work should be published since the Perm-Aseptic Process Company consistently refused to release the formula. The Committee finally decided to publish the work.

It is highly desirable that these substances be investigated further by competent scientists, since they have been ignored in the past and offer a promising new field. The proven value of clothing impregnated with D.D.T. to repel lice, or with repellents to protect against mosquitoes or with fungicides to prevent mildew, should be sufficient encouragement for a trial of these bacteriostatic substances and of their medical uses.

4. Amoebiasis Survey

The Director General of Medical Services consistently tried to foresee and deal with any threat to the health of troops, or that of civilians coming in contact with soldiers. One such problem had to do with the contraction of intestinal parasites by troops operating in the Mediterranean theatre. It seemed desirable to know how many men harbored parasites, and whether there was any danger to themselves or to others.

In the summer of 1944 A.M.D. 8 carried out a survey of soldiers who had returned from the Mediterranean area. These men were hospitalized because of wounds, and not because of tropical disease. The work was carried out under the direction of Capt. M.J. Miller, R.C.A.M.C., at several large military hospitals in Canada. Two hundred and nine men were examined and careful studies were made of the stools. Fifty-seven percent of those examined were found to be infected with some species of protozoa or helminth. Entamoeba histolytica was found in 11% of those examined, whereas a previous study of Canadian soldiers, who had not left the country had shown an incidence of only 1%. This report was the basis for discussion and decision regarding the disposition of amoeba carriers.

It was felt that some of these men might develop amoebic dysentery in the future, but that no treatment should be carried out until such an event occurred. It was further decided that despite the increased carrier rate this was small compared to the total civilian carrier pool. No serious threat from the public health standpoint was foreseen. This view was perhaps too optimistic since a number of infected men later developed severe complications such as liver abscess.

This survey was termed "an excellent and timely study," by the U.S. Navy Medical Research Institute, Bethesda, Md.

5. Nutritional & Environmental Research

Like typhus, malnutrition has always been a scourge of armies. It is true that it usually arises in troops as a result of supply difficulties, but nevertheless in past campaigns ignorance and lack of knowledge has resulted in epidemic outbreaks of nutritional disease which ultimately led to military disaster.

Despite the enormous scientific and technical advances made in all aspects of nutrition since World War I, comparatively few attempts had been made in Canada prior to 1939 to investigate military nutritional problems in the light of modern knowledge. Accordingly, when the Research and Development Division was organized, Brigadier J.C. Meakins selected Lt. Col. Robert Kark to be Officer-in-Charge of Nutrition in A.M.D.5, and arrangements were also made for him to be appointed Officer-in-Charge of Nutrition and Environmental Research in A.M.D.8.

Four major nutritional problems of military importance were investigated. Field trials and laboratory studies were carried out on compact military rations; methods for maintaining nutrition in isolated units were developed; investigations were initiated to study the effects of nutrition and environment on the operational efficiency, physical fitness and general health of the soldier; and finally, researches were carried out on metabolic and nutritional disturbances arising in damaged soldiers.

Twenty-five R.C.A.M.C., two R.C.A.F. and three U.S. Army Officers, and other ranks at one time or another assisted A.M.D.8 on nutritional problems, and twenty-five civilian physicians, scientists and technicians were actively employed on nutritional projects initiated and supervised by A.M.D.8. These civilians carried out their work at the National Research Council, McGill University Medical School, the Fatigue Laboratory of Harvard University, Macdonald College, Queens University Medical School, the Central Experimental Farm, Ottawa, and the Department of Public Health, City of Montreal. Over forty reports on nutritional investigations were presented to the Associate Committee on Army Medical Research, and other reports were submitted to the Sub-Committee on Nutrition, Department of National Defence, Ottawa.

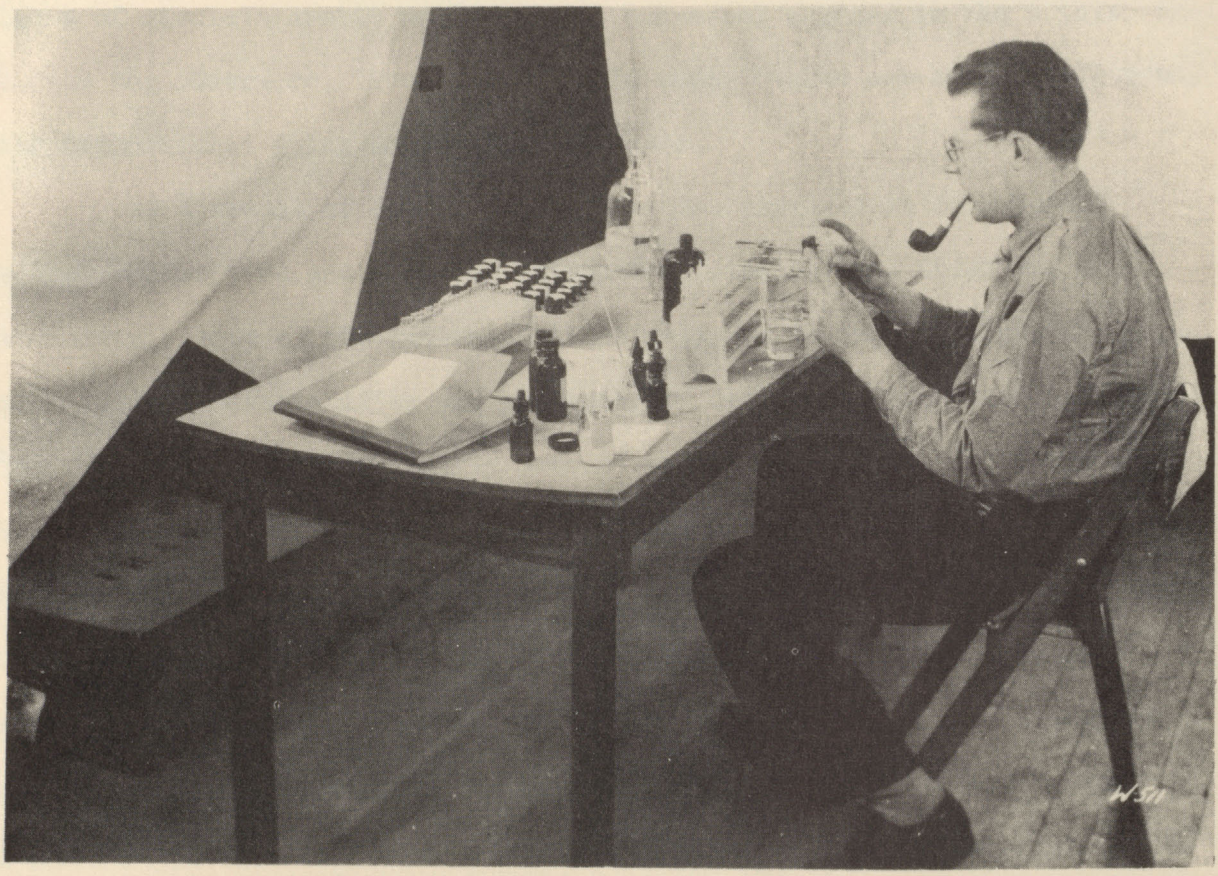
a. The Development of Military Compact Rations

The Penobsquis Trials carried out by Col. W. Hurst Brown and S/L McCreary of the R.C.A.F., set up the basic methods for testing the effect of compact rations on military efficiency in the field. Since then it would appear that field tests of military rations in Canada, in the U.S.A., in England and in India, have followed these concepts and methods. These standards employed in evaluating compact rations were later formalised by Dr. Robert Johnson, S/L J.F. McCreary and Lt. Col. Kark, and were reported to the Associate Committee on Army Medical Research at its fifth meeting.

(i) The Prince Albert Arctic Ration Trials

In the summer of 1943, a small, comparative trial of emergency rations was carried out at the Bush Fighting School, Maniwaki, P.Q., and, while the results were not productive, the personnel employed gained experience which was of great use in the cold weather trials carried out north of Prince Albert, Sask., during the following winter (1943-44). The latter was an ambitious comparative trial of nine Canadian, U.S. Army and British compact rations. It was part of a large, inter-service, Arctic trial of materiel of war, carried out for the Canadian, British and United States Armed Forces.

Dr. Vilhjalmur Steffanson and Dr. A.E. Porsild, the well known Arctic explorers, and numbers of the Royal Canadian Mounted Police, acted as advisers. Dr. Robert Johnson, of the Harvard Fatigue Laboratory, together with two technicians and asisted by Lt. H.F. Aiton and W.O. II E.D. Pease, set up a biochemical field laboratory near the trial area. Medical officers and R.C.A.M.C. corporals were specially chosen and trained at a combined services Arctic School in Toronto. Two officers from the U.S. Army Quartermaster Subsistence Research Laboratory, Major Robert Melson and Capt. Mert



PRINCE ALBERT RATION TRIALS - DR. ROBERT JOHNSON IN MOBILE NUTRITION LABORATORY.

Richardson, assisted actively in the trials, as did Major S. Bliss of the Surgeon-General's Office, U.S. Army. Captains I.M. MacKay, D.W.S. Best, David Bell and J.S. Lewis acted as observers. Two R.C.A.F. medical officers who had assisted Col. Brown at the Penobsquis Trials, S/L J.F. McCreary and F/L Kal Seaman, took an active part, as did Major Pat Cox, R.A., and Capt. Glen Turner of the K.O.R.C., who cheerfully led his test troops through the rigors of simulated Arctic warfare. All personnel engaged in the trials, including the observers, lived in the field under rugged sub-arctic conditions, with temperatures going down well below zero.

As a result of detailed observations, physical fitness tests, medical examination and numerous biochemical studies, the trial was very productive. Many of the recommendations designed to improve digestibility, palatability, acceptability and packaging of compact rations were implemented. Furthermore it was again clearly demonstrated that caloric deficiency seriously impairs military efficiency. This knowledge resulted in an increase of the caloric content of compact rations to a more satisfactory level. Both the U.S. Army 10-in-1 ration and the "C" ration were modified and made more efficient, and certain items in the British 24-Hour ration were discarded and replaced by satisfactory components. As a result of the trial, the Quartermaster-General Canadian Army was able to develop the Canadian Arctic Mono-Pack ration, which was successfully used in the 1945 arctic exercises, "Eskimo" and "Polar Bear".

(ii) Pemmican as an Army Ration

Because of its excellent keeping qualities and high caloric value, "Pemmican" has always been a favourite food component of Arctic and Antarctic explorers, and Dr. Steffanson especially had strongly advocated its use as a single complete military ration. Accordingly a plan for testing "Pemmican" was drawn up following consultations with Dr. Steffanson and the material was manufactured to his specifications by Canadian packers. A thorough trial was carried out, using a "tough" and well-led platoon of test troops.

Despite the previous excellent phyique and morale of the men, (they had marched 47 miles in 36 hours across broken snow-covered country a week before), the third day of the trial brought the platoon to the point of disintegration as a military unit. On the morning of the fourth day they were operationally useless. Examination revealed a group of listless, dehydrated men, with drawn faces and sunken eyeballs. Their breath smelled strongly of acetone. Each man had lost about 7 lbs. in weight during the 3 days and neurological changes were present. Biochemical studies showed ketosis, dehydration, and salt and ascorbic acid depletion.

The function of compact rations is to keep troops in good condition for short periods of time while they are away from their base. It was clearly evident from this trial that pemmican alone, despite its compactness, is not suitable as a military compact ration.

(iii) Ketonaemia and Intestinal Upsets

During the trial at Prince Albert, it was noticed that the platoons living on certain U.S. Army rations complained of excessive flatus with abdominal cramps, and that their urine contained quantities of abnormal ketone-like bodies. These disturbances were investigated in the field and U.S. Army biscuits were found to be the caustive agents. Naturally these findings made quite a stir on the southern side of the border, especially as the platoons living on the U.S. compact rations had lost efficiency. As a result of studies in the U.S. Quartermaster Chicago Laboratory and the Harvard Fatigue Laboratory,

COLD WEATHER TRIALS AT PRINCE ALBERT - EXHAUSTION FROM CALORIC DEFICIENCY.

it was found that overbaking of all types of U.S. Army biscuits made them too hard to be properly digested, and the large residue caused cramps, diarrhoea and flatulence. The ketonuria was due to ingestion of skim-milk powder, which had been used in baking all types of U.S. Army biscuits. Apparently if skim milk powder is held at 420 F. for 20 minutes and then ingested, it is metabolized in the body and ketone-like substances are excreted in the urine. As a result of these findings, the specifications for U.S. Army biscuits were changed and a superior non-toxic biscuit was produced.

As an outgrowth of the above studies, research grants were also made to Dr. H. Crampton, of Macdonald College, and Dr. Eldon Boyd, Queens University. They studied the absorption, digestion and nutritional value of the highly hydrogenated fats which are commonly used in the manufacture of army rations, especially those designed for use in the Tropics. This resulted in valuable information of fundamental character.

(iv) U.S. Army Colorado Trials

In May 1944 the U.S. Army held extensive trials of their own compact rations, which they had modified as a result of the Prince Albert trials. Capt. D. Bell, Lieut. H.F. Aiton and W.O.II E.D. Pease, at the request of the Surgeon-General, were loaned to the U.S. Army for the duration of the trial, and Lt. Col. Kark acted in consultant capacity. At the completion of the trial, Lieut. Aiton and W.O. II Pease went on to the Harvard Fatigue Laboratory and constructed apparatus for a mobile biochemical field laboratory, in preparation for nutritional and environmental studies in forward area. The apparatus was built into 35 portable boxes and was developed by the Harvard Fatigue Laboratory group. These kits were later used in India and Burma.

b. Metabolism in Damage & Convalescence

This large project, which received early and extensive support from the Committee, illustrates vividly how fundamental laboratory work may lead to varied practical applications. During the war years, several groups of workers in the United States, the United Kingdom and Canada had been studying the curious phenomenon of protein breakdown. Their work showed that the body's stores of protein could be rapidly depleted by various types of injury or infection. The breakdown products appeared in the urine and could be measured easily by determining nitrogen. It became apparent that, following such non-specific injuries as a fracture or an abdominal operation, there might be considerable loss of protein. Later during convalescence, the body might hoard protein to build up the tissues. In Canada, work on this subject was centered in the University Clinic, Royal Victoria Hospital, Montreal, under the direction of Dr. J.S.L. Browne and an active group of assistants, who were investigating the effects of endocrine therapy on the phenomenon. At an early stage of the investigation Maj. J.A.F. Stevenson, Capt. H. Stansfield and Capt. P.G. Weil were made available to assist Dr. Browne. The civilian members of his group included Dr. Martin Hoffman, Dr. Victor Schenker and Dr. E.H. Venning, while Dr. M.E.F. Hunter and Dr. W.A. Andreae also contributed to the work. In the fall of 1943, at the request of Brigadier Meakins, Lt. Col. Kark and Dr. J.S.L. Browne drew up plans for Dr. Browne's group to study the effects of Nutritional therapy on this phenomenon. Subsequently R.C.A.M.C. personnel were made available as ward assistants and arrangements were also made for injured Army personnel to be studied at the Royal Victoria Hospital.

The project was of a fundamental nature, and was one of several long-term projects supported by the Army Committee. It was not expected that any

METABOLISM AND CONVALESCENCE – (1) RECOVERING BURN CASE ON SPECIAL METABOLISM WARD.

immediate practical result would come from this. Some very practical applications did however emerge.

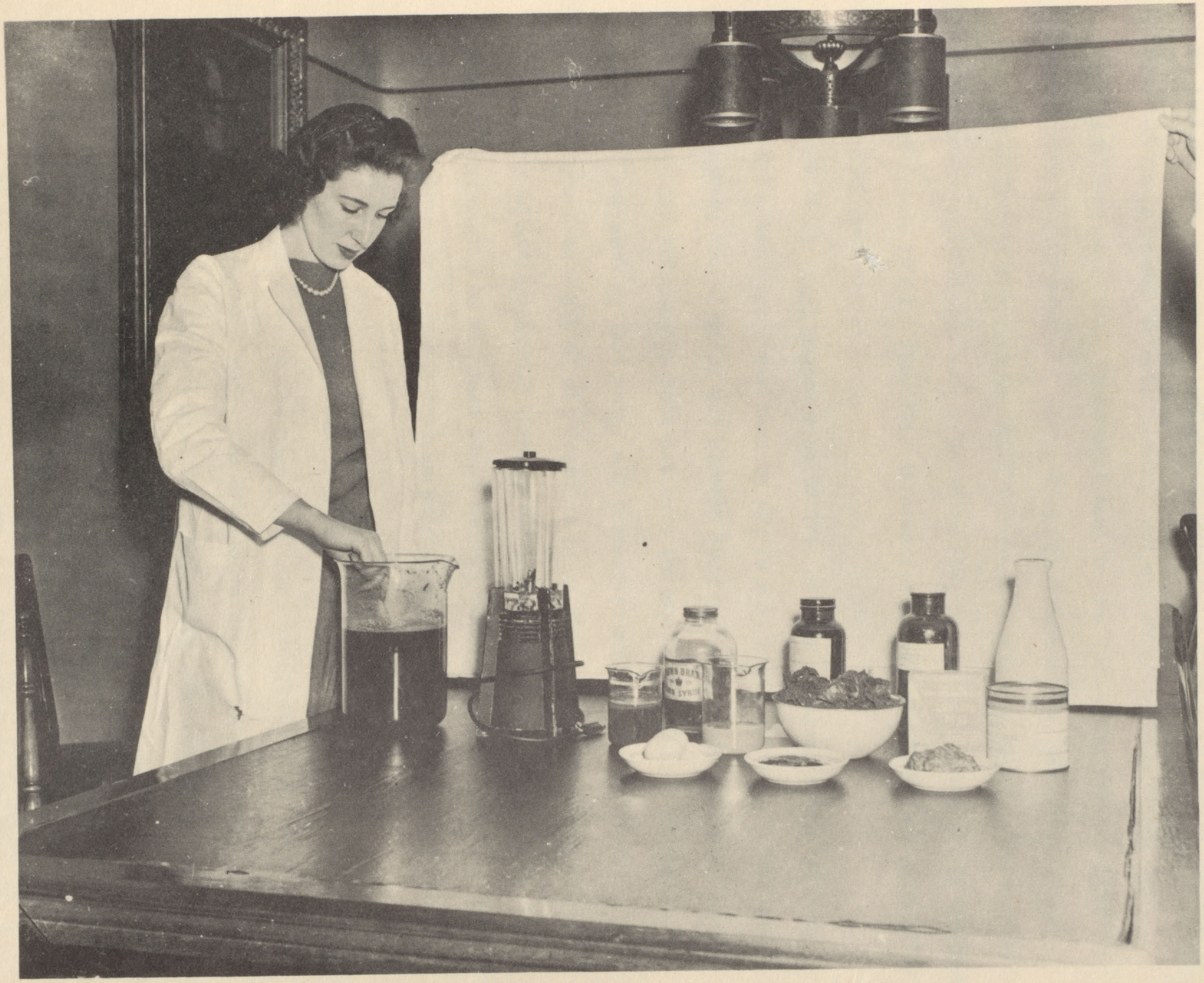
It came to light that the great loss of weight suffered by some hospital patients was due to poor dietary supervision and since protein breakdown was greater than the protein obtained from the food a negative protein balance resulted. It had long been suspected that Army hospitals were no better than civilian hospitals when it came to the proper feeding of patients and it was decided to make a brief survey of the situation. A nutritional team consisting of Lt. Col. R.M. Kark, Maj. J.A.F. Stevenson, and Maj. Gwen Taylor, was therefore sent to Chorley Park Military Hospital, Toronto, and Camp Borden Military Hospital. Groups of patients were selected. Their intake of food was weighed and charted over a period of some days. The amount of food left on their plates after meals was also weighed. It was thus possible to show that due to underdrawal of rations by the Quartermaster, wastage during cooking and unpalatable food left uneaten, patients were only getting about half the calories and protein laid down on the scale of issue. It was also found that even though the sick soldier lost weight his general attitude was that since he was in bed he should not be eating very much. The doctors' neglect or ignorance of proper feeding methods was also a potent factor.

Following this disclosure, the team was sent by D.G.M.S. to all military hospitals in Canada to give lectures and demonstrations and to show charts, illustrations and films on hospital nutrition. A later survey of the above-mentioned hospitals made by Capt. Joan Whittaker, R.C.A.M.C., showed a very considerable improvement in patients' food intake. This improvement was partly due to better hospital catering and nutritional care but also to the introduction of concentrated supplementary feedings.

During the first hospital nutritional survey, Maj. J.A.F. Stevenson realized that it was desirable to develop a simple method of increasing the caloric and protein content of the patients' diet. One way of doing this was worked out in collaboration with Miss Helen Sutherland. They developed a series of recipes for milk shakes, which were very much higher in food value and protein than an ordinary milk shake. These were given to patients between meals as supplementary feedings and proved most successful.

In view of the value of high-calorie, high-protein milk shakes, it was felt that they should be made available to the Canadian hospitals overseas, where our wounded men would receive the benefits at the earliest possible moment. This brought up the problem of providing ingredients which could be easily shipped overseas without spoilage. The original recipes developed in Montreal called for the use of fresh milk and raw eggs which were out of the question. To solve this problem the assistance of Dr. W.H. Cook, Director, Division of Applied Biology, National Research Council, Ottawa, was obtained. It was decided that an effort should be made to produce a milk powder, which could be shipped in large volume overseas. This powder could then be reconstituted in the hospitals by addition of water, and when properly flavoured could be served as a milk shake. It was found impossible to add powdered egg since "off flavours" appeared.

Within a few weeks a suitable powder was developed at the N.R.C. with the assistance of Capt. D.R. Gibson of the Directorate of Supply & Catering, N.D.H.Q., and the Borden Milk Company. This was given the official name "Department of National Defence Powdered, High-Protein Milk Supplement." A trial shipment of this powder, along with various flavourings, was sent at once to the School of Home Economics, Macdonald College, where a large number



Metabolism and Convalescence - (2) Experimenting with new milk-shake recipies.

of recipes were made up and tried out under the guidance of Miss M. McCready. From the large number of experimental recipes, about a dozen of the most promising were selected. These were sent to the University Clinic, Royal Victoria Hospital, Montreal, where Miss Helen Sutherland, Dietitian under Dr. J.S.L. Browne's direction, made the final acceptance tests. The various concentrated milk shakes were offered to sick and injured patients, to determine which were best liked. When this information was obtained, it was decided to get material overseas at once.

A small trial shipment of 50 lbs. of powder, along with a variety of flavouring materials, was sent by Air in May, 1945. This was tried out at Basingstoke Neurological and Plastic Surgery Hospital at once and found to be heartily welcomed by both patients and staff. In July a shipment of 1000 lbs. was sent by fast ship, and thereafter shipments were kept at a level to meet the needs of all Canadian hospitals overseas. The materials were obtained and despatched through the normal processes of the R.C.A.S.C., but were consigned to No.1 Base Depot Medical Stores in Great Britain, and were thereafter distributed through Medical Stores upon requisition from the hospitals.

A similar programme was developed for hospitals in Canada but since priority had been given to overseas hospitals, the plan was not working fully in Canada until August, 1945. The directives for preparation and use of these high-calorie, high-protein food supplements were issued by D.M.S., C.M.H.Q. and D.G.M.S., N.D.H.Q. during the summer of 1945. This development was therefore a very happy outgrowth of the fundamental studies carried out in Montreal.

c. Research Team South East Asia Command

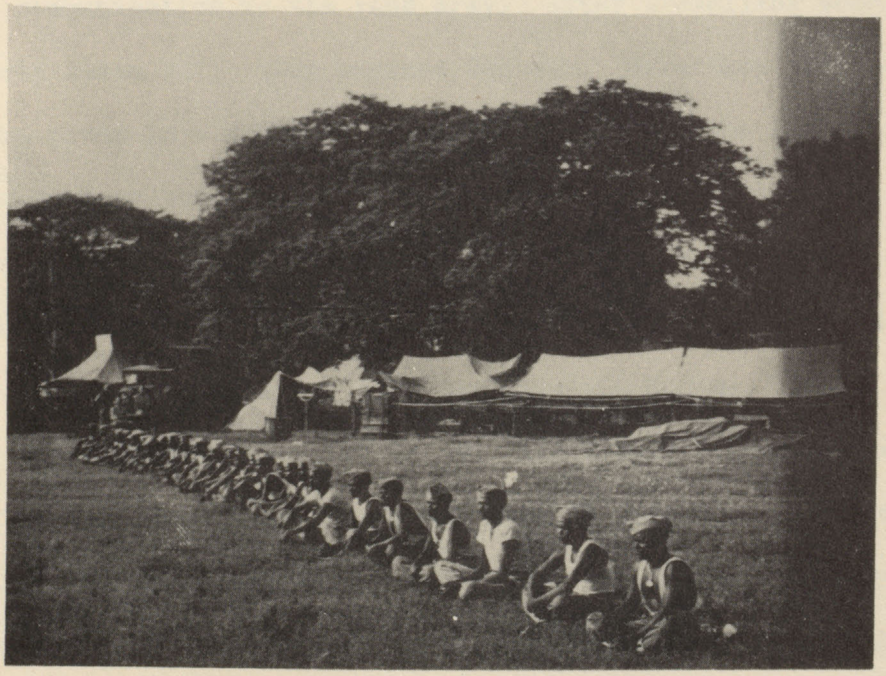
During 1943 the planning staff of A.M.D.8 foresaw the probable need for nutritional investigators to enter the liberated areas after our troops had invaded Europe and freed the half-starved inhabitants. A mobile nutrition laboratory was therefore organized, with Lt. Col. Kark in charge as previously described. Following D-Day on May 8th, 1944, there was little interest shown at first by Allied Commanders in such nutritional investigations. Later on they were urgently requesting them. In any event at this time A.M.D. 8 had a nutrition team that was all dressed up with no place to go.

Early in 1944, however, close liaison was established between A.M.D.8 and Brigadier Digby Welch, Director of Operational Research, Allied Land Forces, S.E.A. The feeding and nutritional status of Indian soldiers of the 14th Army (Burma) was causing some concern at this time and a request was therefore made by South East Asia Command to D.G.M.S. for the loan of a small Research Team to study problems in the field. Accordingly in the late fall, Lt. Col. R.M. Kark, Lieut. H.F. Aiton and W.O. II E.D. Pease, together with the mobile biochemical field laboratory were flown out to the South East Asia theatre of operations.

Arrangements were made for the Team to work with the Indian Biological Research Team and the Research Directorate, A.L.F.S.E.A., and plans were laid for them to carry out nutritional and environmental studies on Indian soldiers fighting on the Burma front, to carry out trials of Indian compact rations and to investigate feeding problems in the forward areas. When these assignments were completed, the Team was to move to the rear to study para-sprue and nutritional problems in Indian Military Hospitals. A temporary War Establishment was drawn up, vehicles, equipment and orderlies were made available and the Team was attached to No. 11 Operational Research Group, 14th Army.

On arrival in India the Team first moved up to the User Trial Establish-

(1) Nutrition Team, India - WO.II E.D.Pease, Lt.Col. R.M. Kark and Lt. H.F.Aiton near Mobile Nutrition Laboratory.



(2) Nutrition Team, India - Native Troops Awaiting Nutrition and Physical Fitness Survey.

ment, near Derha Dun, where, during a short period of acclimatization and familiarization, they conducted a survey of physical fitness, general health and nutritional status of Ghurka reinforcements and also carried out jungle field trials of the Indian Composite (8-man) Ration Pack. In this study and a subsequent study in the field, they received a great deal of help from Lt. Col. John Squire, R.A.M.C., Commanding the Indian Biochemical Research Team, and also from three of his officers: Maj. Joseph Doupe, R.A.M.C., of Winnipeg, Major T. Renbourne, R.A.M.C., and Capt. N. Myant, R.A.M.C. During the jungle trial, assistance was also given by three medical officers, Capt. J.A. Harrison, R.A.M.C., Capt. Hemphill, R.A.M.C., and Capt. Stein, R.A.M.C., all of whom had belonged to General Wingate's Chindits.

From Derha Dun the team, together with Capt. Myant, and two Indian sepoys who had been trained as laboratory assistants, moved down to the Calcutta headquarters of A.L.F.S.E.A., and from there up the very long lines of communication to the 14th Army. After travelling some days in the rickety Assam Mail, they reached Gauhati. Here they shipped across the Bramaputra river in a ferry boat and transferred to the Ledo Road railway line. At manipur base (Dimapur) they picked up unit vehicles, stores and equipment, as well as the remaining orderlies and M.T. drivers. The journey down the Manipur Road, which cuts through dense jungle and winds over wild precipitous mountain country, took ten days via Kohima, Imphal and Indangye. Crossing the Chindwin River, at Kalewa, the Research Team joined the 14th Army at Monywa. From here they moved with 11 Operational Research Group and later with 10 Operational Research Section across the Irriwaddy to Meiktilla, and then down the Mandalay Road to Pwebwe, Naunglabin, Pegu and Rangoon.

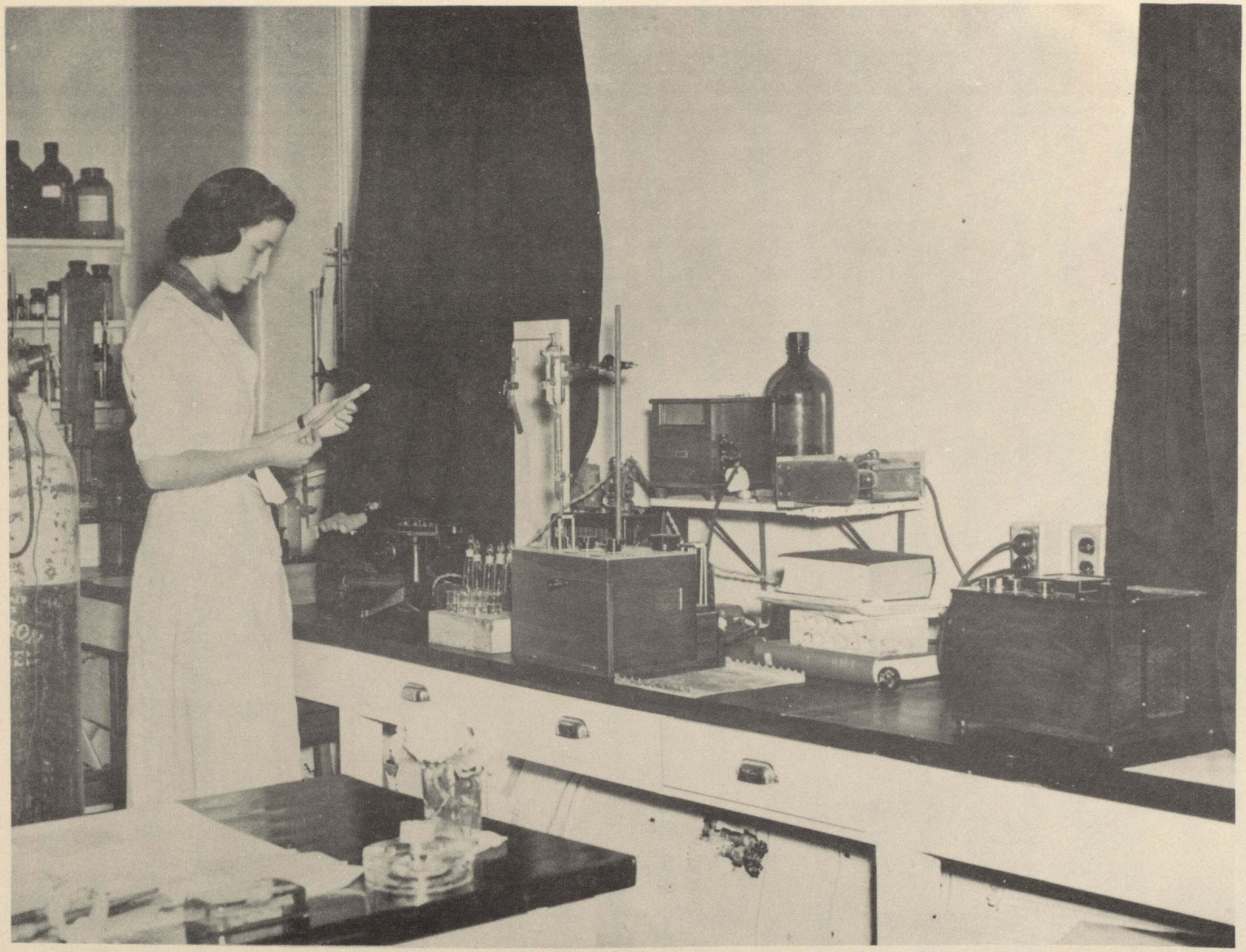
In Burma the team made observations on the activity and environment of 23 different units, and did complete clinical, nutritional and biochemical studies on over 1000 Indian soldiers. The biochemical estimations included measurements of blood haemoglobin, serum chloride and vitamin C, and urinary chloride, vitamin C, thiamin, riboflavin and methyl-nicotinamide. Observations were made in the field on food preparation, on wastage and underdrawals of ration items, on the usefulness of various compact rations, on the acceptability of various types of foods and on the effects of religious and racial prejudices and habits of nutrition. A group of Japanese prisoners-of-war were also investigated and a study was made on tank crews during the operation Monywa-Meiktilla-Rangoon.

d. <u>Miscellaneous</u>

(i) Nutrition, Environment & Physical Fitness

Inadequate food supplies, poor catering, bad food preparation, monotony and badly organized messing, all tend to decrease the nutritional value of meals prepared from a fixed scale of rations, such as is used by the Canadian Army.

Accordingly, a nutritional and environmental survey was carried out in the spring and early summer of 1943, to determine the effects of Army feeding and basic training on the health, physical fitness and morale of newly enlisted soldiers. Approximately 100 draftees and 25 R.C.A.M.C. medical students were studied. Their civilian socio-economic status, dietary habits, food intakes and family and educational background were assessed by Miss Therese Marion of the Department of Public Health, Montreal. Lt. Col. Robert Kark, Maj. J.S. Smit and Dr. M.E.F. Hunter, Royal Victoria Hospital, with the assistance of civilian technicians, conducted clinical and biochemical studies and measured physical fitness before and after basic training, and, with Miss Marion, assessed environmental factors in the Basic Training Centre.



NUTRITION SURVEY - SPECIAL APPARATUS FOR VITAMIN ANALYSIS, ROYAL VICTORIA HOSPITAL, MONTREAL.

On the whole the physical fitness, nutritional status and morale of the draftees when first examined, left much to be desired, especially when compared to the medical students, who acted as controls.

After the initial examination was completed, the draftees were sent to three Basic Training Centres. At the end of two months' training they were completely re-examined. In one of the three camps, the environment was considered excellent, that is, living quarters were clean and bright, the kitchens were spotless, mess halls were painted in attractive colours, and decorated with curtains, and the grounds of the camp had been made attractive with grass and flowers. Military discipline was of a high standard. Furthermore, the Commanding Officer was interested in the nutritional care of his men and insisted that the Army ration be fully utilized and that meals be varied, properly prepared and attractive. The food intake of the men was excellent and very little money was spent on buying foodstuffs in canteens and in restaurants outside the camp. In a second basic training centre, the opposite prevailed. Here the rations were considerably underdrawn, garbage pails were filled with discarded food, canteen sales were extremely high, and the men were buying large amounts of pastries, candies and soft drinks. This was the direct result of serving poorly prepared, monotonous and unacceptable meals in dingy mess halls and surroundings.

Improvement in morale, in physical fitness, in weight and in clinical and biochemical nutritional standards of the draftees were most marked in the camp where the environmental conditions and nutritional care had been excellent. Little or no improvement, and poor military discipline, was noted among the draftees in the poor camp. In the third camp, an intermediate situation was found.

In the opinion of those who made the observations, draftees trained in the excellent surroundings of the first basic training centre, had acquired, through proper diet and environment, the drive necessary for more complete and thorough assimilation of the benefits of basic training.

(ii) Hydroponic Vegetable Growth

Geographical location and enemy activity may isolate soldiers from their supply of food, and under such situations nutritional disturbances are likely to arise. Apparently, vitamin pills do not provide all the factors necessary to maintain optimum nutrition and if soldiers are isolated for long periods of time, it is well to supply them with adequate amounts of fresh vegetables. In northern Canada, especially Goose Bay, Labrador, isolated Army units were stationed to provide ground defence for air force and radar installations. Initially, because of low priority, air supply of vegetables was not possible, and since the soil at Goose Bay is sandy, acid and barren, it was not possible to grow vegetables. It was decided to try to apply hydroponic growth methods in this northern outpost. Hydroponic agriculture consists of seeding vegetables or other plants in beds made up of sand or clinkers and supplying nutrient chemicals at regular intervals to support plant growth.

Dr. H. Hill, Central Experimental Farm, and Lieut. John Gilbey, R.C.A.S.C., both interested in hydroponic agriculture, were asked to co-operate in this project. Dr. Hill flew to Goose Bay to make a soil survey and later acted as advisor on hydroponics. Lieut. Gilbey was in charge of actual operations at Goose Bay.

In the spring of 1943 two types of hydroponic beds were set up. A concrete type, of which only one was built and in which the nutrient chemical solutions were pumped up from a tank into the sand bed twice a day. In a second wooden type, of which 86 were built, the chemicals were surface spread

HYDROPONIC VEGETABLE GROWTH – MR. JOHN GILBEY AND LT. COL. R.M. KARK EXAMINING A BED OF LETTUCE.

and watered by hand. To get over climatic difficulties, a hot house was built to force young plants during the prolonged northern spring. The sand beds were raised well above the ground to protect plants from ground frost, warm nutrient solutions were used and special care was taken to see that the plants were not damaged by icy rains, which occur in Labrador even in midsummer. Special, hardy and quick-ripening northern varieties were planted, and by the middle of summer it was not uncommon to see soldiers, with their rifles slung over their shoulders, coming straight off sentry duty and wandering among the beds touching and fingering the growing plants.

A good yield of a variety of vegetables was obtained in the first year. Some of these were flown down to form an exhibit at the meeting of the Association of Military Surgeons in Philadelphia. The exhibit aroused great interest.

During the 1944 season the project was taken over by the Directorate of Supply and Catering for operation. In that year, however, an area of about 25 acres of arable land was discovered in the vicinity. The hydroponic method could obviously not compete with this. It is agreed, however, that the two years of experience with the hydroponic method laid the groundwork for successful cultivation of the soil in that region.

The application of hydroponic growth to northern climate, where malnutrition has always prevented colonization, may be an important step in the agricultural development of the north. With the development of hydro-electric power, there is every reason to hope that further researches in this field will one day produce profitable crops and assist in the opening up of Canada's hinterland.

(iii) Sprouted Seeds as Nutritional Supplements

In the absence of fresh vegetables, sprouted beans and peas can be used to prevent scurvy. This ancient Chinese therapeutic measure was used again in this war by the Russians, during the siege of Leningrad, and by the Australian forces during the Owen Stanley Campaign.

At Macdonald College, in Dr. McFarlane's laboratory, Mr. W.A. Andreae and Miss E.A. (Jean) Chalmers investigated over one hundred varieties of sprouted beans and peas. They determined optimal methods for producing vitamin C and other vitamins, by the germination of seeds, in military installations and in the field. Attractive recipes were also developed to make sprouted materials acceptable without destroying their nutrient value.

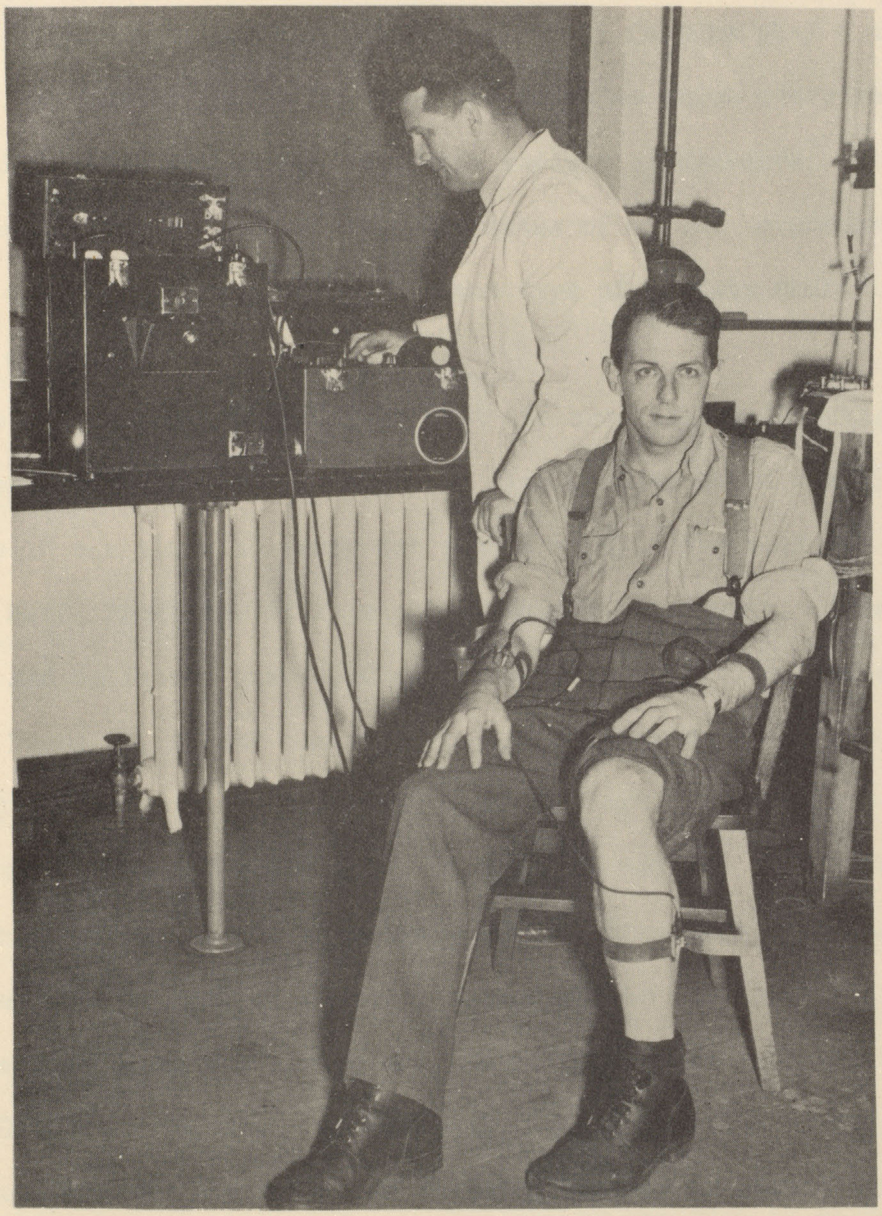
All in all the work on nutrition not only produced new ideas but kept the Army on its toes in this respect and kept the importance of proper feeding constantly before the eyes of all.

6. Effort Syndrome

This strange condition has come to light during many wars, and was notably described after the American Civil War and World War 1. It is marked by undue fatigability, palpitation, breathlessness and chest pain. It undoubtedly exists in peace time, but the victims naturally filter into sheltered occupations in which they are not put under strain. The condition is uncovered at once, however, when the individual is exposed to military training.

Effort syndrome is of great importance because it is a cause of large wastage of man power. Many thousands of victims are turned down at induction, or are discharged later during military training. Many thousands were pensioned in Great Britain after the last war. The mechanism of the disorder is quite

Sprouted Seeds - Various Stages of Growth.



EFFORT SYNDROME - DR. H.E. HOFF OBTAINING ELECTROCARDIOGRAM.

unknown, but some individuals appear to have been constitutionally affected since childhood. Others have developed the condition after severe infections, and in still other cases anxiety and psychological factors play a prominent role. There has been a recent swing of the pendulum which overstresses the role of psychological mechanisms in a wide variety of diseases. This has led uncritical people to believe that all cases of effort syndrome are of psychogenic origin and are merely a variant type of anxiety neurosis. This is a dangerous attitude.

The officers of A.M.D.8 felt that the army should investigate this condition for the reasons given above and also because there was little opportunity - save in war time- to carry out such a study. The task was entrusted to Dr. H.E. Hoff, Professor of Physiology, McGill University. A large number of draftees and enlistees suspected of having this condition were screened at District Depot No. 4, and numerous special studies were carried out in the Depot by Maj. M. Aronovitch, Maj. W.D. Ross and Capt. Stansfield. Attempts were made to predict which men would later fall by the wayside in military training. Special psychological studies were made, and the Rorschach test was employed on a large scale. A study of postural change of the circulation and its response to various drugs was also made. In collaboration with Dr. J.S.L. Browne, University Clinic, Royal Victoria Hospital, it was possible to hospitalize a number of soldiers who had failed in training because of Effort Syndrome. Careful nitrogen balance studies were made to determine whether their condition caused any abnormality of nitrogen metabolism, such as occurs following injury or infection. No such abnormality was found. Some animal studies were also made by Dr. Hoff. Although these did not contribute directly to the problem of Effort Syndrome, they were important from the standpoint of mechanism. All of the detailed reports have been published in the Proceedings on the Associate Committee on Army Medical Research.

One is left with the impression that the key to this problem lies in the study of the physiological and chemical mechanisms involved. So much is known to-day concerning the normal control of respiratory and cardiac rate and rhythm that similar approaches should be used in the attack on Effort Syndrome.

7. Aural Damage and Rehabilitation

From the beginning of the war, there was a growing interest and anxiety over the effect of continued or periodic loud noise, vibration and concussion on the hearing of service personnel. This was of interest to the Air Force, from the viewpoint of noise of aircraft motors in relation to inter-communications systems. The Navy had its problems, not only from gunfire, but also from the high noise levels present in Fairmile engine-rooms. From the Army viewpoint, there was reason to fear the effects of concussion and noise from big guns, or even from prolonged exposure to small arms fire or tank machinery. It seemed possible that, even if damage had not been severe enough to be recognized by the soldier, or be picked up during perfunctory hearing tests at discharge, his reserve might have been encroached upon. He might thus develop deafness in later life, and it might truly have been connected with service.

Early in 1944 it was decided to investigate this matter and Capt. H.H. Jasper was sent to the United States to survey the problem. He made a complete report to D.G.M.S. The following needs and objectives of the Canadian Army were then laid down by A.M.D.8.

R.C.A.M.C. AUDIOMETER IN USE AT NEW SOUND-PROOF INSTALLATION,

MONTREAL MILITARY HOSPITAL.

(i) Development of a simple and quantitative method of estimating the auditory acuity of men on induction or discharge examination.

(ii) Survey of incidence of permanent auditory damage in soldiers, in relation to arm of service, viz. tank crew, artillery personnel, machine gun personnel, etc.

(iii) Provision of protective devices.

(iv) Study of part played by loud or continuous noise in production of general body fatigue.

(v) Institution of routine audiometric tests at time of discharge.

The task of developing suitable audiometric equipment was given to Dr. Hector Mortimer, at the Montreal General Hospital. He had pioneered in the development of audiometric equipment and had at his disposal a completely soundproofed room, of which there were but two in Canada at that time. Supported by the Associate Committee on Army Medical Research, and with the help of the Northern Electric Company, Dr. Mortimer developed a unique type of audiometer for the Canadian Army. This instrument was operated by remote control, the patient being alone in the soundproof room. Pure tone and warble-tone acuity thresholds could be determined, and a masking noise generator was incorporated. Hearing acuity for speech, (using a high fidelity generator with hand-monitored voice or gramophone disk) could be done either at threshold or above, and in the presence of noise. Signals could be applied to either ear or both. The equipment was designed to be easily adaptable for the testing and fitting of hearing aids. This "R.C.A.M.C. Audiometer" was the standard instrument proposed for use in the Aural Rehabilitation Programme of the Canadian Army. Again, as with Night Vision work it was Prof. E.G. Burr, McGill University, who had earlier laid down some of the fundamental characteristics for this apparatus.

Efforts were also made to provide the Canadian soldier with some form of protection for his ears. A crude type of rubber ear plug was available on the scale of issue, but it was found to be quite inadequate and mainly of historical interest. The "Ear Warden," developed by N.D.R.C., at the Psycho-Acoustic Laboratory, Harvard University, had been specially designed, and a number of tests had demonstrated their utility. Samples of these were obtained and tested at one of our Artillery Training Centres. Approximately 100 officers and men used the ear plugs during firing practice, over a considerable number of days. The wardens were found to be satisfactory and it was recommended that the previous type be declared obsolete, and that the wardens be placed on the scale of issue. This was done during 1944 for the Army in Canada, but overseas the troops continued to rely on cotton-wool as advised by the consultant otologist, British War Office.

It is necessary that soldiers be educated to protect their ears, since they are apt to adopt the attitude that they are "tough" and can get along without ear plugs. An indication of the danger has been given by Surg. Lt. A.K. Mighton, R.C.N.V.R. He described various injuries incurred by the crew of his small escort vessel during a short engagement with a German submarine. No fewer than seven men suffered ruptured ear drums from their own gunfire.

It had been planned to survey soldiers returning from combat areas, to determine the incidence of auditory damage and to learn what type of injury was most likely to cause it. To this end, a submission was made for the construction of two soundproof rooms, one to be built at the Montreal Military Hospital and the other at Chorley Park Military Hospital, Toronto. It was decided to go ahead at first with the Montreal unit, until the size of the problem had been assessed. The installation was nearly complete by the end of 1945.

Early in 1945, the Research Division began to get a broader view of what was necessary in the way of looking after soldiers with auditory damage, and Lt. Col. D.S. McEachern was sent, by the Director-General of Medical Services, to visit one of the three Aural Rehabilitation units set up by the Surgeon-General's Office of the U.S. Army. As a result of this visit a plan was drawn up, based on the American scheme, for an integrated programme of Aural Rehabilitation for Canada. This recommended the setting up of a centre at the Montreal Military Hospital, where service personnel, with deafness sufficient to be a handicap, could be sent for a 2½ months' course. This was to include lip reading, speech re-training, auricular therapy, psychological advice, selection and fitting of the best possible hearing aid, and, finally, employment guidance.

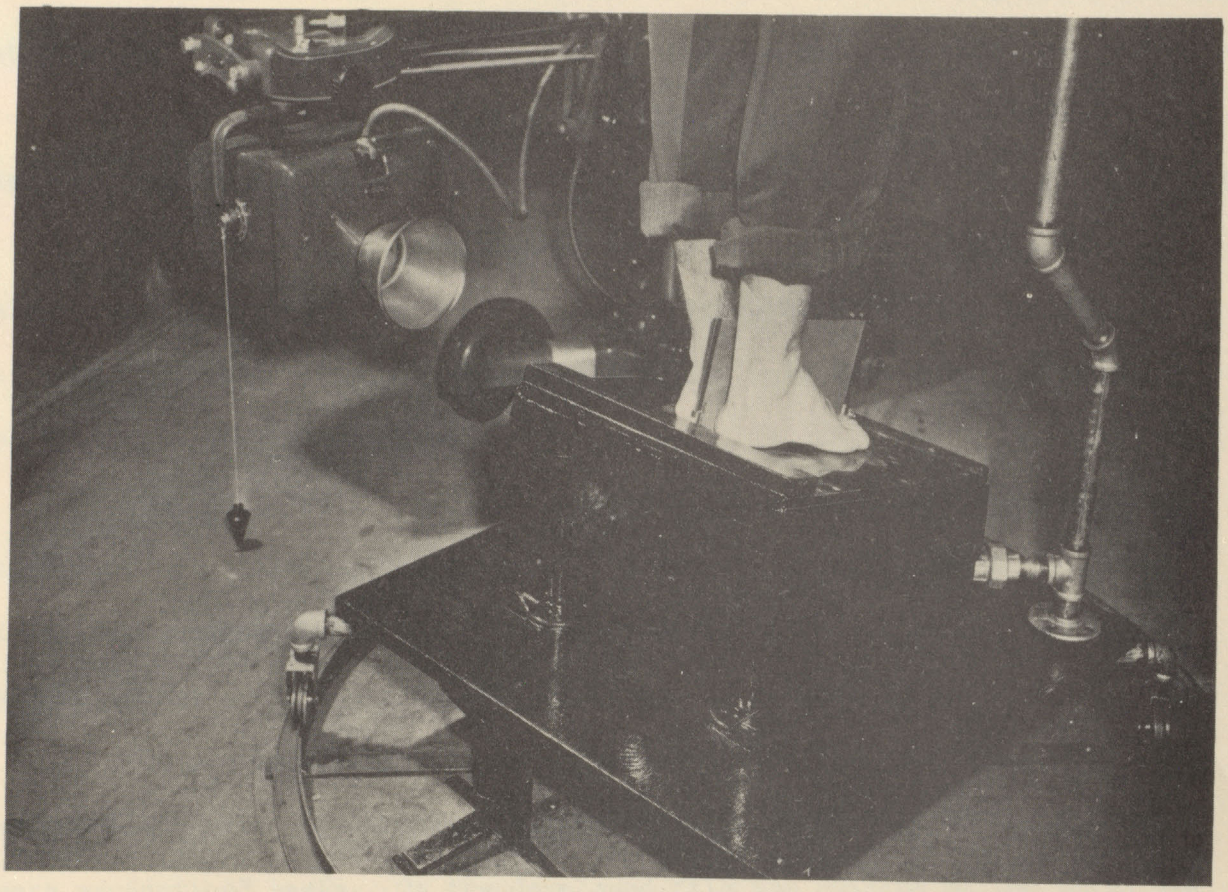
This proposal was approved by the Director-General of Medical Services and it was planned to organize the centre as an Inter-Service Special Treatment Centre, which would ultimately pass into the hands of the Department of Veterans' Affairs. The setting-up of the centre was therefore undertaken by Dr. W.P. Warner, Chairman of the Medical Advisory Committee, Special Treatment Centres, and Director-General of Treatment Services, Department of Veterans' Affairs. It was planned that the sound-proof installation and the special audiometric equipment, developed by the R.C.A.M.C., would serve the newly-organized Aural Rehabilitation Centre. The new installation at Montreal Military Hospital opened early in 1946. It consisted of a Wing containing a highly sound-proofed room (attenuation 111 decibels) especially designed by Mr. Cecil McDougall. The massive, thick-walled structure was literally almost suspended in space to prevent vibration. Two adjoining rooms housed records and the latest model

R.C.A.M.C. Audiometer. The unit was under the direction of Maj. E.T. Smith with Sgt. Ruth Kyle acting as Audiometric Technician. Dr. Mortimer retained an active part as Consultant. The unit set a standard for the rest of Canada as regards equipment and trained personnel. It was in full operation by April 1946.

8. <u>Foot Problems in the Army</u>

The present era of mechanization and mobile warfare has certainly not reduced the importance of a soldier's ability to march. Since casualties from disabilities of the feet were a problem both in training centres and in the field, Col. R.I. Harris and Maj. T. Beath initiated and carried out extensive studies on the factors responsible for such breakdowns. The plan was to examine a large number of men on induction into the army and to re-examine them later during basic training and during advanced training. In this way it was hoped to spot the men who were breaking down with foot ailments and to find the reason why. It was also thought that valuable anatomical data could be collected bearing on normal variations of the human foot.

During the whole of 1944 and in the early part of 1945 the above-mentioned officers conducted a survey of over 2500 recruits who passed through the reception centre of Military District No. 2. Careful clinical examinations were made on the men's feet. A new type of foot printing pad was constructed and Capt. John MacKenzie, working with Maj. Beath, developed a new technique for taking X-rays of the feet. So many men were surveyed each day in this great undertaking that the X-ray tube had to be packed in dry-ice to prevent overheating. Maj. George Ferguson of A.M.D. 2 was responsible for statistical analyses of the collected data, and Pte. R.E. Conway and nine other soldiers



FOOT SURVEY - LATERAL X-RAY.

were fully employed on clerical and investigative duties. Dr. Harry Gates gave his advice on anatomical problems as they arose.

The collected data were recorded on statistical sorting cards for later analysis in a machine. When the men were re-examined at training centres, the development of symptoms of foot disability were noted. Observations were also made on the methods used for training recruits to march, and on boots and other factors which might give rise to foot problems in the Army. It may be said that at this stage of the war Training Officers were found to be most intelligent in their rules for graduated marching. As a result, foot breakdowns due to stupid over-marching were not common.

The foot printing pad which was developed was unique in that it was capable of demonstrating the outline of the foot in contact with the ground as well as showing the areas of excess pressure on the sole. It was made of rubber, it was compact and not too expensive to produce

The new technique for taking X-rays of the foot made it possible to carry out accurate, comparative studies of the architecture of the foot on a "mass production" basis. On the developed film the outline of the talus and calcaneus in the superio-inferior view could be studied and in addition, lateral and oblique view measurements could be made. By these techniques it was possible to establish normal figures for certain bone variables, especially those associated with atavism of the first metatarsal bone. Details of the foot printing and X-ray techniques can be found in the appropriate N.R.C. reports.

It was found that in the Army there were many factors which produced foot disabilities and it was felt that the incidence of casualties could easily be cut down by appropriate administrative action. Suggestions for eradicating administrative and other causes of disability were given in the final report. This report contains a mine of information for anatomists and anthropologists. (Ref. C.6200).

The clinical investigations did not confirm Morton's concept that a short first metatarsal bone is related to foot disability. As a matter of fact, there was no causal relationship between a short metatarsal bone and disability in the group of soldiers studied. On the other hand, a new concept of the cause of disabling flat foot was presented by Col. Harris and Maj. Beath. They found a new clinical entity which they described under the name of "Hypermobile Flat Foot with Short Tendo Achillis." These cases were shown to occur in association with a weakly supported head of the talus.

There has probably never been any survey of man's feet or their ailments carried out with such care and on such a monumental scale as this one. It is hoped that all those interested in the subject will consult the final report which was published in the Proceedings of the Associate Committee on Army Medical Research.

9. Respiratory Disease Research

One of the greatest causes of man-power wastage in the Army, or in any other group, is acute respiratory disease. This was well illustrated during the training period for Canadian troops.

Late in 1942, proposals for study of respiratory disease were made by Col. Hurst Brown, and in February 1943, a working unit was established at Camp Borden, Ont. Maj. W.R. Feasby was instructed to make a survey of the incidence of acute respiratory disease in the Canadian Army and to direct a study of influenza and atypical pneumonia. While the outlines of this picture were being drawn, material from the hugh volume of acute respiratory cases

Respiratory Disease Research - Lt. Col. W.R. Feasby and Dr. E.T. Bynoe.

occurring in Camp Borden was collected and studied. Arrangements were made for Dr. Ronald Hare, of the Connaught Laboratories, to investigate nasal washings and other materials taken from patients suspected to be suffering from influenza. At Camp Borden Military Hospital, Major John Hamilton and Major T.E. Roy isolated haemolytic Streptococci from the sputa and respiratory tracts of hundreds of soldiers. Streptococcal cultures were sent to the laboratory of the Department of National Health, Ottawa, where Dr. T.F. Bynoe and Dr. G.D.F. Cameron did serological typing.

At Camp Borden, meanwhile, an estimate of respiratory disease casualties showed that on an average, each man in the camp lost five training days per annum as a result of upper respiratory infection. With a Home War Establishment of 200,000 men, over a million training days might therefore be lost each year by the Canadian Army in Canada. Coincident with this discovery, it was found that certain units had much less respiratory disease than others.

It was already known by experiment that the quiet air during the hours of sleep was almost free from streptococcal contamination. Immediately on reveille, vast increases in plate counts were demonstrable. In the Units which had the worst records this increase was unnecessarily and enormously aggravated by the practice of each man dry-sweeping the floor between his bed and the next, into the centre of the hut. The ensuing duststorm might inoculate every man in the hut. Such units had sickness rates greater than those which practised wet-sweeping and frequent washing of floors <u>after</u> the men had left the huts.

A comparison was made with the Air Force establishments at Camp Borden, and it was demonstrated that although both services suffered from extreme over-crowding, the construction of Air Force huts with hardwood floors, and modern ventilation systems, undoubtedly contributed to lower rates in the

RCAF. The Army huts of that day were floored with badly creviced softwood, heated by a series of oval stoves, and they were not ventilated. Small wonder then that men brought from homes all over Canada should have serious training delays due to sickness. When the importance of these findings was realized, a campaign was launched to tell soldiers how to prevent the spread of respiratory disease. Articles were published in Service Journals, lectures were given to Army Personnel all over Canada and film strips were prepared to instruct all ranks. This work was carried forward through 1943 and 1944 by Maj. Feasby, working from A.M.D.8.

In this job the First Canadian Army film strip for Medical Services was produced. This was called "The Control of Airborne Disease" but because lay perception sometimes confused this with aerial bacterial warfare the title had to be changed to "Control of Respiratory Disease." This film strip was shown thousands of times, in Canada and Overseas, and undoubtedly contributed to the reduction in respiratory disease rates. A.M.D.8 also brought about the establishment of an adequate Film Strip Division in the National Film Board. Through Army Medical Research co-operation the National Film Board was provided with an art staff. The personnel were given special training in the United States and were equipped with special apparatus. This Film Strip Unit continued to serve Service health fields and, in 1945, was assisting the health education of Canada in appropriate Governmental departments. At first this development seemed to be an insignificant frill on the fabric of Medical Research, but it developed into a valuable weapon for health.

The work on streptococcal infection led far afield. In the detailed studies of the manifestations of streptococcal illness the investigation paid special attention to the complications. A clinical study was conducted on sulfatherapy in acute streptococcal otitis media, and the treatment of soldiers suffering from scarlet fever was also investigated. It was confirmed that, unless a purulent complication of scarlet fever occurred, chemotherapy with the sulfonamides was not beneficial. Moreover, its use in uncomplicated scarlet fever was dangerous in view of the possibility of sensitization. In addition, detailed studies were made on acute streptococcal pneumonia. This condition was found to be a medical emergency requiring rapid and intensive chemotherapy if the patient's life was to be saved. An investigation was also made into the interesting and little-explored field of the skin manifestations which follow or occur with streptococcal infection. These include erythema nodosum and so-called erythema multiforme.

The manifestations of streptococcal illness are varied, and a detailed study of rheumatic fever developed out of the initial work. Rheumatic fever is perhaps the most serious end-result of streptococcal infection, and every patient who had manifestations of rheumatic fever was followed carefully for two years. The close relationship to the streptococcal waves was striking. The end results were shocking. After two years a follow-up showed that 70% of those who had rheumatic fever had been invalided out of the Service and of these, 70% were totally disabled and pensionable.

As a result of the studies on streptococcal infection there developed a greater appreciation of proper therapy in streptococcal pneumonia and an improved isolation procedure in the acute respiratory wards of hospitals. This experience led to the making of a film strip for the instruction of R.C.A.M.C. personnel in proper isolation technique. This film strip was used in Nurses' Training Centres. It was important because it established in their minds the appreciation of a great problem.

The studies on influenza provided useful information about the distribution of the influenza virus and about the clinical nature of the illness. Over a period of four years material from influenza patients was collected by officers in charge of Medicine at the Camp Borden Military Hospital. At first this was done by Col. Hurst Brown, and then by Maj. John Hamilton, and finally by the team referred to above, which collected the material from 1943-44. The material was collected and frozen in a specially designed cabinet. It was then sent to Dr. Hare in Toronto, who by animal and serological examination, investigated the predominant infecting agent. It was found that there was no recognizable pattern of influenza A and B infections, but the precise infecting agent for this large group of cases was determined in each of these years. An important contribution was the first discovery and description of an isolated epidemic of influenza A infection in the spring of 1943.

Atypical pneumonia as a complication of influenza was also studied, but not on a wide scale. It was observed, however, that pneumonia was a complication of influenza A or B infection. It was also noted that about 15% of all cases with influenza developed pneumonic signs and suffered an illness which was difficult to distinguish from atypical pneumonia. This will need further investigation especially in relation to influenza, influenzoid, and other virus, pneumonic infections.

By 1943-44 A.M.D.8 had gathered sufficient evidence from its own research projects and surveys and from liaison with workers in the U.S. and U.K. to permit firm recommendations being made. These were passed to A.M.D.5 (Preventive Medicine & Hygiene), and were as follows:

(a) Aerosols and ultra voilet light, while effective under ideal conditions, are not practicable measures for the Army as a whole.

(b) The use of sulphonamide prophylaxis is effective in reducing upper respiratory disease, but the danger of producing sulpharesistant strains is so serious that it should only be used as an emergency measure to terminate epidemics.

(c) Simple measures of dust control should be enforced since they are practical and capable of effecting substantial reduction in sickness rates. The measures recommended were:

(i) Wet-sweeping of huts.
(ii) Oiling of floors and blankets.
(iii) Stricter attention to barrack cleanliness.
(iv) Blankets to be shaken and aired outside huts.
(v) Education programme to be energetically maintained.

(d) Recommendations were also made to avoid overcrowding of huts, to require hardwood floors in building of new huts, to improve ventilation and abolish where possible the heating of barracks by stoves.

A.M.D.5 was able to report sharp decreases in upper respiratory disease, due to streptococcal infections, following the introduction of this programme. There is no way, unfortunately, to prove that this was not purely a coincidence, but it was a welcome change from the hitherto existing state of affairs.

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10. Motion Sickness Remedies

From its inception, the Research Division was interested in the development of better remedies for motion sickness. There was an uneasy suspicion that this condition might prove to be more serious for Army personnel than for men in the Navy or Air Force. The latter were exposed frequently to the motion of ships or air craft. It seemed likely that they would either be grounded if repeatedly disabled or would become immune through acclimatization to motion. Army personnel, on the other hand, might be carried in very large numbers in landing craft and assault boats, or in air craft or gliders, without an opportunity to become acclimatized. They would be expected to land and go into immediate action. Even though the majority would not be disabled, there might be a considerable reduction in fighting efficiency. Much work had been carried out, under the Sub-committee on Motion Sickness of the

Associate Committee on Naval Medical Research, and this resulted in the highly publicized R.C.N. "Pink Pill." It was nevertheless felt by the Army group that the final chapter had not been written on seasickness remedies, and that a better one could be developed.

Work was actively pursued under the auspices of the Army Committee, by Dr. R.L. Noble, at the Institute of Endocrinology, McGill University.

This project was based on the use of barbiturates for the treatment of such conditions as motion sickness and hypersecretion of the stomach. In 1942 the thesis was presented that it might be possible to find a new drug, such as one of the barbiturates, which would specifically affect the brain centres involved in motion sickness. Such action might indeed be achieved without the usual hypnotic effects of some barbiturates. The Abbott Laboratories prepared some 150 compounds and donated them for this problem. Eli Lilly and Company also generously supplied some 25 derivatives.

Tests were made on dogs and the various motion factors responsible for vomiting were analysed. This work was carried out on swings and a boat was also used to good effect on the open reaches of the Ottawa River. As a result, a standardized method was evolved for assaying the effectiveness of drugs on dogs. It was soon shown that many barbiturates had the power to prevent motion sickness in 100% of dogs without giving rise to any side reactions. The protective action was apparently specific and not related to other properties commonly associated with barbiturates. In order to test these new drugs for toxicity and anaesthetic properties extensive tests on rats and dogs were carried out. Few of the compounds had been previously studied; none by oral administration.

It was apparent that no drug could be used as a seasickness remedy if it produced sleepiness or foggy vision or in any other way reduced the fighting efficiency of the soldier. It was therefore necessary to determine how the most promising compounds would be tolerated by humans. A series of experiments of this nature was arranged by A.M.D.8 and conducted by the staff of the R.C.A.M.C. Training Centre at Camp Borden. Some barbiturates were found to have little or no hypnotic action or other side effects, and seemed worth testing against motion sickness. Arrangements were therefore made to test human volunteers from Researve Army Units in Montreal and from McGill students. These tests were initially carried out on a special machine which had been developed at the Montreal Neurological Institute.

There are certain points of interest in the development of machines for producing motion sickness in man. The first attempt in Canada was made by a group under the direction of Dr. Donald McEachern at the Montreal Neurological Institute, with the stimulus of Dr. Wilder Penfield and the support of the Associate Committee on Naval Medical Research. Plans were laid to build a large machine to simulate a ship's movements. The first step was a visit to "Belmont Park," an amusement spot near Montreal. Here, with the co-operation of the Manager, free and prolonged rides were taken on the Ferris wheel, "Shoot-the-Chute," "Flip Over," "Loop-the Loop" and other so-called pleasure devices. The researchers returned at the end of the afternoon, a wan and bedraggled lot. They now knew, however, the type and degree and frequency of oscillation that would be necessary to produce sickness. These features were built into a large machine capable of pitching and rolling like a ship and in which the human volunteer could be seated. This machine was designed by Dr. Andre Cipriani. Later it was shown that simple upward and downward motion was effective. This was learned by taking a group of volunteers to the

Sun Life Building in Montreal. Here they were installed in a high speed express elevator which was made to go up and down over a distance of about 10 feet. Later it was shown by R.C.N. and R.C.A.F. workers that large swings were capable of producing motion sickness. It was easy to build a battery of these swings and in this way to test a number of men at one time. This method was finally adopted by all workers because of its simplicity. It was the method used by Dr. Noble in both his human and animal experiments.

Dr. Noble's first step was to determine the reliability of repeated testing. A preliminary study was made by Capt. H.H. Jasper, Mr. M. Bornstein, Dr. R.L. Noble and Mr. A. Battista.

Definite standards had to be laid down as to what signs and symptoms indicated a state of motion sickness. Furthermore, because of the importance of psychological factors in the precipitation or prevention of sickness, it was necessary to use, in each test, a group of control subjects who received a placebo (dummy pill). The effectiveness of any drug was always stated in terms of the percentage of men protected from motion sickness as compared to those fed dummy pills. Such measures were necessary for accurate work.

Motion sickness is due to oscillatory stimulation of the labyrinths of the ears. These are the organs which normally help us preserve our balance and tell us, even when our eyes are closed, what position we are occupying in space. Other factors, such as sights and smells and unpleasant memories, may contribute to the onset of sickness but they are not fundamental. The popular conception of seasickness being "All in the mind" is certainly false.

And now let us turn to Dr. Noble's experiments. Assays of effectiveness against motion sickness in man were made on the chosen barbiturates, on belladonna mixtures, on the Royal Canadian Navy remedy and on other substances.

Motion Sickness Swing - Capt. J.A.F. Stephenson in Contemplative Mood.

A barbiturate designated as V-12, (Ethel B-methyl Allyl Thiobarbituric Acid) was found to be the most effective remedy against motion sickness produced on the swings. It was recommended, therefore, that sea tests be conducted using this substance alone and in combination with belladonna mixtures which had previously been shown to have good protective value. Various tests were conducted by other workers, and in part by the U.S. Navy, who carried out large scale tests in landing craft off the California Coast at San Diego. These tests, arranged by A.M.D. 8 through Dr. Denny-Brown of Boston, showed that V-12 was of real value. Its performance under operational conditions was, however, about the same as that of two other of the best remedies. Undoubtedly an even more effective remedy will eventually be found.

The central action of barbiturates on gastric secretion was also investigated in the hope that a centrally-acting depressant of gastric acid could be found which might prove of therapeutic value in cases of peptic ulcer, where gastric acid is poured out too plentifully. Tests were conducted on cats with permanent gastric fistulae. Insulin was used as a central stimulant. A great many drugs were given in an attempt to inhibit the insulin-stimulated secretion. There was only one compound which caused a diminution or cessation of secretion in some animals. Since this compound was not toxic, A.M.D.8 arranged to have it tested on humans. A series of tests was made by R.C.A.M.C. Officers at the Rideau Military Hospital, Ottawa. Although some inhibiting effect appeared after an ordinary test meal, no inhibition of alcohol-induced secretion was found. This stumped the experts. Towards the end of the war a highly active compound was found in animal tests. If toxicity tests proved satisfactory, Dr. Noble hoped to test it on humans. Two barbiturates were also found which had the opposite action. These were powerful stimulants of secretion. They apparently acted through a central mechanism and were effective when taken orally.

11. Air Transport of Casualties

It was foreseen early by A.M.D. 8 that the Army Medical Authorities should be prepared for the time when casualties might be returned to Canada by air. It was known that practically any casualty did well when carried by aircraft over short distances at moderate altitudes. On the North Atlantic Route, however, it might be necessary to fly between 10,000 and 20,000 feet. It was therefore necessary to learn what problems might have to be faced for the preparation and care of casualties in high altitude flight. What about the expansion of intestinal gases? the effects of various drugs at reduced pressure? the effects of high altitude on intracranial pressure?. There were no answers at hand to these questions. The task was undertaken by Capt. E.W. Peterson, under the direction of Capt. H.H. Jasper, at the Montreal Neurological Institute.

A comprehensive survey of these problems was made by Capt. Jasper during a visit to the U.S. Army Air Force Aero-Medical Laboratories at Wright Field, Ohio, and the U.S. Navy Medical Research Institute at Bethesda, Md. A report of these findings was submitted to the Director General of Medical Services. This recommended improved types of litters for installation in aircraft, and the training of personnel in "Air Ambulance" work for the care of Canadian Army Casualties.

A specially designed decompression chamber was installed at the Montreal Neurological Institute. This made possible detailed investigations of the effect of simulated altitude upon: (A) Intracranial pressure as related to wounds of the head, (B) Morphine Tolerance, (C) Patients with pneumo-

Evacuation of Wounded by Air – Interior view of the Decompression Chamber.

thorax, (D) Patients' reactions to sulphonamide drugs, (E) Gases within the gastro-intestinal tract.

This work was carried out in collaboration with Dr. William Cone, Dr. Fraser Gurd, Capt. Eric Peterson, S/L Basil Kent, R.A.F., and Mr. Murray Bornstein in association with the Sub-committee on Surgery of the Associate Committee on Medical Research of the N.R.C.

It was found that there was practically no condition, except perhaps acute abdominal injury, which contra-indicated transportation of wounded by air. There seemed to be no great difficulties, provided oxygen was made available and medical officers were properly instructed in the preparation of patients and their care during flight. The R.C.A.F. already had these factors in hand. Details of these studies and recommendations were presented in a series of reports to the National Research Council, and in a number of open publications.

The war ended without the organization of any Canadian system for the return of casualties by air across the Atlantic. It was stated that hospital ships were preferable from the viewpoint of weather, comfort and dependability. Long before the end of the war the Americans were, however, flying back casualties by the thousands over the North Atlantic. It seems a pity that Canada did not develop some similar set-up. It would have brought a number of advances. It would have given Canadians the experience of flying casualties, under conditions certain to be of value after the war, when Canada would have service personnel in outlying garrisons. It would have provided for the return of priority cases where each day was a matter of importance. These instances would have included patients urgently needing special plastic work; men dying of malignant and other conditions (who should have been returned to their families at once on compassionate grounds); cases of peripheral nerve injury requiring early suture; and many other cases of special type.

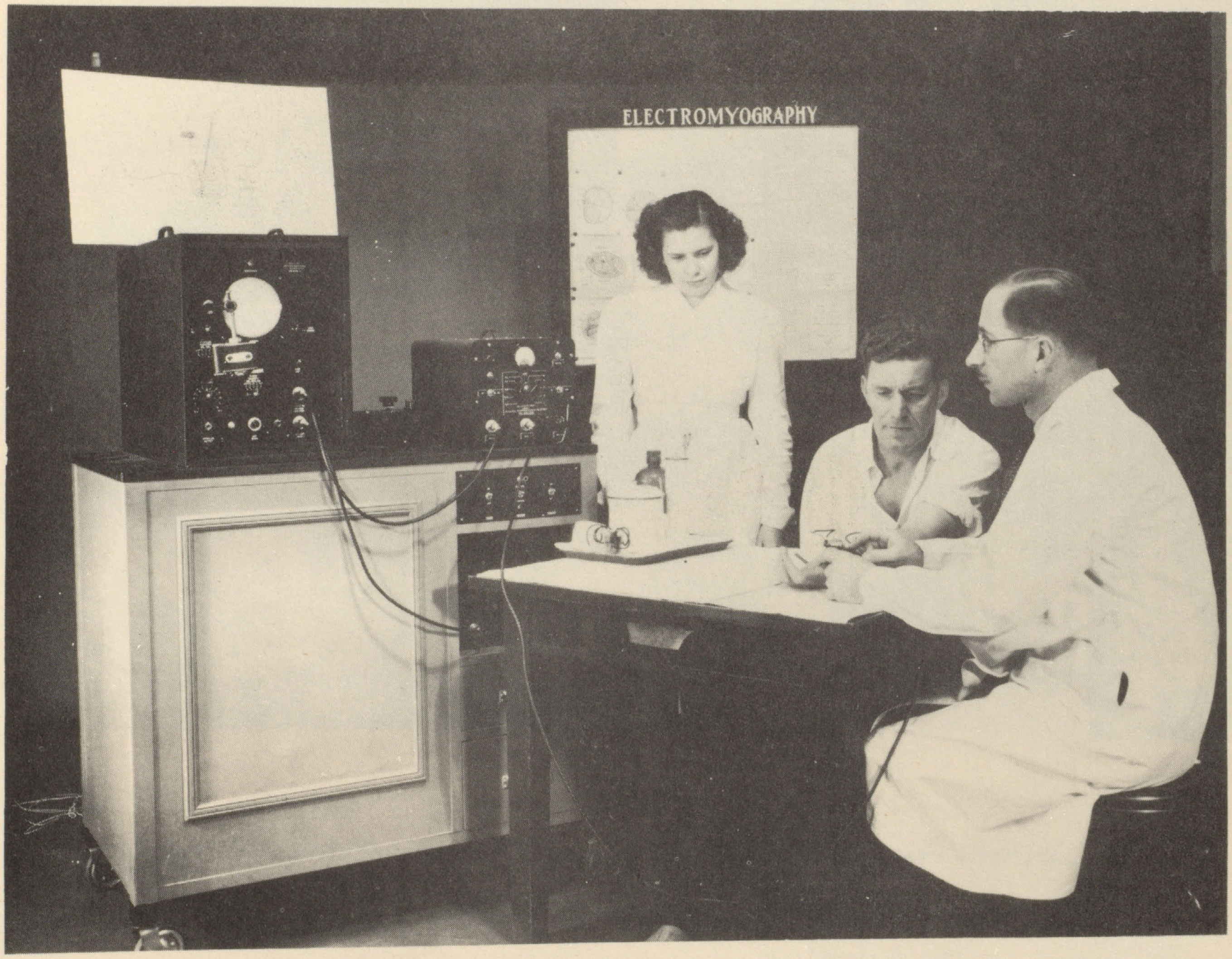
12. Traumatic Injuries of the Nervous System

In the spring of 1944, a comprehensive programme of research was set up covering a number of medical and surgical problems related to the care, treatment and assessment of men with traumatic injuries of the nervous system. This project was under the direction of Capt. H.H. Jasper, R.C.A.M.C., Electro-physiologist at the Montreal Neurological Institute. The research was still in progress at the end of the war. Collaborating in this work were Dr. K.A.C. Elliott, Mr. Murray Bornstein, Surg. Cmdr. Preston Robb, R.C.N.V.R., S/L John Kershman, R.C.A.F., Mr. John Meyer and Sgt. Leslie Castles, R.C.A.M.C. Towards the end of the war there was added the valuable assistance of Capt. William Forde and Sgts. Watson and Wixon of the R.C.E.M.E. Important consultation and advice was obtained from Col. Wilder Penfield and Lt. Col. William Cone and other members of the Sub-committee on Surgery of the Associate Committee on Medical Research.

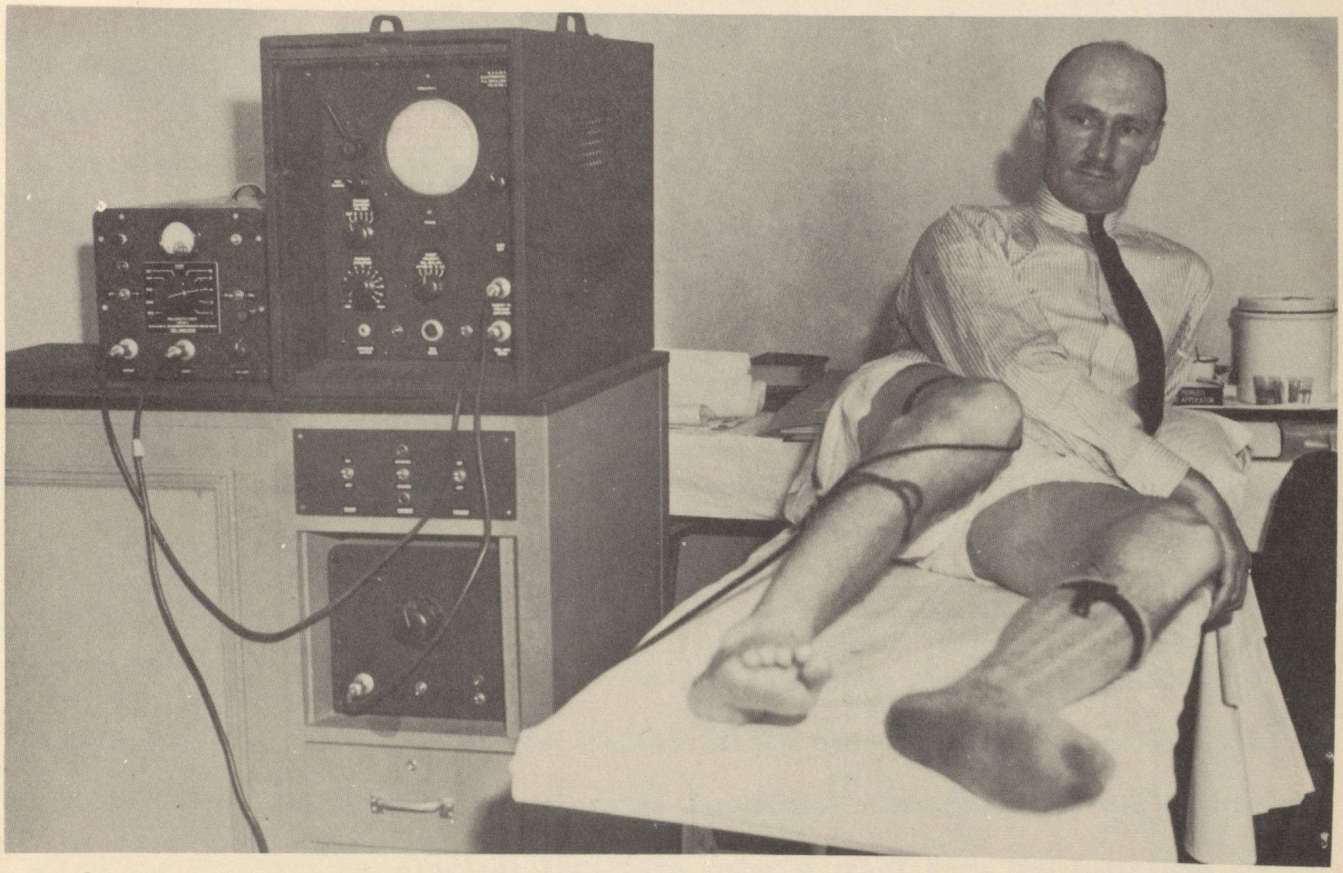
(a) Peripheral Nerve Injuries

Research in this field was concerned principally with the development and construction of clinical electromyographic apparatus for the diagnosis and prognosis of peripheral nerve injuries. An effort was made to assess the value of electromyography as compared to other methods of peripheral nerve examination. Initial animal experimentation gave confirmation to the earlier work of Wedell and his colleagues at the Nerve Injury Centre of Oxford, England, where electromyography had been developed as a valuable aid to the study of peripheral nerve injuries.

Electromyographic examinations were carried out on over 300 service men with nerve injuries, also numerous experimental studies were carried out



DR. H.H. JASPER AND MISS MARJORIE MATTHEWS RECORDING ELECTRICAL CURRENTS FROM VETERAN'S WOUNDED ARM.



R.C.A.M.C. ELECTRO-MYOGRAPH IN USE AT MONTREAL MILITARY HOSPITAL.

CASE OF NERVE INJURY.

on cats and monkeys. The method was proven to be over 90 per cent accurate in diagnosis when compared to observations of the condition of the nerve at operation and when validated against clinical studies of patients expected to recover. Recovery could be detected in the E.M.G. in about half the time required to observe the usual clinical signs of recovery of voluntary motion.

In a combined study of peripheral nerve injuries with Dr. Lewis Pollock and Associates, U.S. Office of Scientific Research and Development, the electromyograph was found to surpass other methods in predicting the condition of the nerve as compared to that found subsequently at operation. These co-operative studies were carried out at the Percy Jones Hospital Centre, Battle Creek, Michigan. Capt. Jasper went there on two occasions for short but intensive surveys of the clinical material. He took the R.C.A.M.C. electromyographic equipment with him.

The new R.C.A.M.C. electromyograph (Mark iii) was therefore provided for each of the five special centres for the treatment of nerve injuries in Canada, and Medical Officers were trained in the use of the apparatus by Capt. H.H. Jasper at the Montreal Neurological Institute. The apparatus was constructed at the Montreal Neurological Institute under a grant from the Associate Committee on Army Medical Research. It proved to be the best designed and most useful electromyograph available for clinical use and requests for the equipment were soon made by the Russian Government National Research Council, Washington and University laboratories.

In addition to the electromyograph, the R.C.A.M.C. dermohmmeter was developed for the measurement of electrical skin resistance in cases of nerve injury involving the sympathetic supply to the skin. It proved to be an accurate and objective method of mapping out denervated areas of skin in peripheral nerve injuries. This apparatus was also provided to all special treatment centres for nerve injuries and medical officers were trained in its use.

There was a further extension of the Army programme for studying peripheral nerve injuries. This consisted in the granting of financial aid to Rudolf Altschul, a neuro-anatomist at the University of Saskatchewan. Dr. Altschul conducted a number of fundamental studies on nerve repair and on the effect of drugs and hormones. These were published in the Proceedings of the Committee.

(b) Head Injuries

Studies in this field were directed toward the better understanding of the physio-pathological mechanisms underlying traumatic brain injury. This was in order to provide more rational therapy for men with brain wounds. The aspects of this complex problem which were studied extensively included (1) Changes in electrical activity of the brain produced by experimental methods, (2) The value of electro-encephalography in the diagnosis of post-traumatic and other forms of epilepsy, (3) The effects of various irrigation fluids upon the exposed brain, (4) Brain swelling or edema following traumatic injury or exposure, (5) The presence and action of acetylcholine in experimental trauma of the brain.

Except for clarification of the role of electro-encephalography in traumatic brain injury, up to now little of a strictly practical nature has come from these researches. Studies in progress at the end of the war showed promise of providing a superior irrigating fluid for the brain during operation. This offered hope for the prevention of brain swelling (a frequent, and sometimes fatal complication of brain injury), and for the provision of adequate metabolic substrates for improved healing of injured brain tissue.

13. Army Industrial Hygiene & Occupational Disease Control

Rapid expansion of Canada's army, so necessary to the early war effort, led to the use of unsatisfactory workshops. In some instances these were located in temporary army buildings and were often not suited to army purposes from the standpoint of personnel employed and occupational hazards.

Interest in the problem of environmental hygiene was stimulated by a preliminary survey of Camp Borden workshops, made at the request of the Commander. Random air analysis in wheel and track storage and repair hangars showed concentrations of carbon monoxide which not only led to ill health and reduced efficiency but which were actually dangerous. Suitable control measures were lacking.

Evidence of significant absorption of lead was found on examination of tradesmen exposed in spray painting shops, vehicle body repair shops and battery shops. Inspection of workshops indicated lack of uniformity and lack of minimal standards of control.

A project to determine the Army's needs for industrial hygiene was therefore undertaken. This was supported by the Associate Committee on Army Medical Research. It was directed by Maj. Harvey Cruikshank of A.M.D.5 (Hygiene and Preventive Medicine).

Most army workshops in Canada were surveyed with a view to the detection of specific occupational disease hazards. A temporary laboratory was established at Camp Borden Military Hospital, equipped to make carbon monoxide determinations on air and blood samples. The R.C.A.F. carbon monoxide indicator was initially used but later determinations were made with an M.S.A. Hopcalite carbon monoxide indicator. The Scholander-Roughton micro method was used to determine carbon monoxide concentrations in blood.

In storage and maintenance hangars under winter conditions, complaints of ill-health such as headache, fatigue and gastro-intestinal disturbance were common among hangar personnel. This was readily understandable for air samples were found to contain 65-400 parts per million of carbon monoxide under ordinary working conditions. Blood samples taken under normal working conditions were found to contain up to 25% carbon monoxide haemoglobin.

In view of these facts an attempt was made to determine the rapidity with which the air of a hangar 120' x 80' would be significantly contaminated by tank engine operation. It was found that on the average one tank engine idling at 1000 revolutions per minute in a previously aired hangar for ½ hour produced a carbon monoxide concentration of 250 parts per million at breathing level. When three tanks were idled for 15 minutes in a previously ventilated hangar, concentrations in excess of 600 parts per million were produced. This investigation was important since air-cooled engines had to be stored in heated hangars in winter to facilitate starting and engines had to be "warmed up" for 15 minutes before tanks were moved. It was obvious that if 40 tanks were "warmed up" simultaneously casualties would occur.

The following recommendations were made:

(a) That ventilation be installed of capacity sufficient to maintain average carbon monoxide concentrations at or below 100 parts per million. (b) That carbon monoxide alarm systems be installed in tank hangars. (c) That carbon dioxide-oxygen resuscitation equipment be readily available in the event of asphyxiation.

Although the carbon monoxide problem in motor transport garages was insignificant compared to that in track hangars, suitable ventilation was seldom found. In certain instances however exhaust fumes were conducted to the open air by means of flexible tube exhaust connections.

Numerous air samples were taken in motor transport garages under winter conditions. Seldom was the carbon monoxide content found to be below the maximum permissible concentration of 100 parts per million.

It was recommended:

(a) that local exhaust ventilation be installed to remove exhaust gases. (b) that where local exhaust ventilation was not effective general ventilation be provided sufficient to maintain carbon monoxide concentration below 100 parts per million.

A survey was also made to determine the hazard from carbon monoxide in tanks under standard training conditions. There was no indication that the health of instruction staff or C.A.C. student personnel was adversely affected. The fire pattern under training conditions was such that significant exposure to carbon monoxide from gun fumes did not occur.

Lead

Three main sources of exposure to lead in army workshops were discovered:

(a) Spray painting. (b) Vehicle body repair (lead filling).
(c) Battery salvage and repair.

Spray painting caused exposure to petroleum coal tar and ester solvents and to lead dust. In most instances adequate ventilation was not provided and respirators were not regularly worn. Body repair produced exposure to solder fumes and dust. Lead burning during battery salvage and repair caused a less important though significant exposure to lead. As a result of the discovery of a fairly high percentage of tradesmen with clinical evidence of lead absorption the following recommendations were made:

(a) That minimum standards of ventilation for spray painting be established. That ventilated spray booths with orifice air velocities of 100-200 F.P.M. be provided. (b) That approved filter respirators be provided and suitably maintained for all personnel exposed to lead. (c) That all personnel be given preplacement and periodic examinations for the early detection of lead absorption.

As a result of the above surveys an Industrial Hygiene Committee was formed at National Defence Headquarters to advise district industrial hygiene committees and to draw up minimum standards for working conditions. Represented on the Committee were Directorate of Works & Construction, Royal Canadian Electrical & Mechanical Engineers and Director General Medical Services.

Among other accomplishments, minimum standards of design and ventilation for spray paint shops were developed and a standard filter respirator for spray paint was put into general use. New ventilation was installed in track hangars and standard methods of controlling carbon monoxide in wheel-vehicle garages were developed. Finally on the purely medical side provision was made for the periodic examination and replacement of tradesmen exposed to lead. The above measures undoubtedly contributed much to the health and efficiency of army tradesmen.

14. Winter Equipment Trials Held in Canada and Newfoundland and at Sea.

During the winter 1943-44 a large part of the energies of A.M.D.8 was taken up with the extensive winter test trials held across Canada and at sea.

These trials were conducted in different areas to include conditions of dry cold and wet cold; on the land, at sea, and in mountains - on foot, in vehicles, and on ships and submarines. They were held under the aegis of the Chiefs of Staff Sub-committee on Protective Clothing, and they involved collaboration of the ground, sea, and air forces of Canada, Great Britain, and the United States, as well as interested civilian agencies in these countries.

Col. Hurst Brown took an active part in the initiation of these activities and throughout the year, as representative of the D.G.M.S. on the Chiefs of Staff Sub-committee, he was kept busy planning the trials. Through

COLD WEATHER CLOTHING TRIALS - (1) TESTING CAMOUFLAGE VALUES.

COLD WEATHER CLOTHING TRIALS - (2) BETWEEN THE BIRCHES.

his efforts A.M.D.8 was able to supply one quarter of the officer and N.C.O. personnel of the test and observer staffs. R.C.A.M.C. officers were in charge of the Eastern Trials, the Ration Trials, and the Armoured Corps Trials, and in addition the testing of medical equipment and methods of maintaining health and efficiency was mainly the responsibility of medical officers from A.M.D.8.

Although the trials originally were planned to test protective winter clothing and personal equipment, the broader view put forward so often by Col. Brown was adopted. The exercises were then directed finding the best methods of maintaining health and fighting efficiency of the soldier in the cold. Besides trials of clothing and equipment, combat and support rations were tested, also medical equipment, man-borne carrying devices and methods for evacuation of wounded. Furthermore, training and tactical manoeuvres in snow and cold were developed and practised.

The trials were held under operational or simulated operational conditions. Over four hundred items of clothing and equipment, such as goggles, skis, tents, stoves, sleeping bags, packboards first-aid kits, toboggans, winter gas masks, and breathing devices were tested. Eight combat rations were given extensive trials. Tents were tested for carbon monoxide retention. Plasma was given at sub-zero temperatures. Oxygen was used for the treatment of frostbite. New methods of man carriage were developed. Ice bridges were built, and ice concrete forts were constructed. These are only some of the activities undertaken by the test groups.

The results obtained during that winter have been reported in detail and in abridged forms to the Chiefs of Staff Sub-committee. Some of the reports were presented to numerous other committees, such as the Standing Committee on Nutrition and the various Associate and Co-ordinating Committees of the

National Research Council.

The value of the tump-line carriage of military stones, equipment, and ordnance supplies was thoroughly proven.

The tests on medical equipment which were reported to the Associate Committee on Army Medical Research by Capt. J.S. Lewis stimulated many new developments designed to improve medical care in the field, and initiated studies on the tropicalization of R.C.A.M.C. equipment which were carried on jointly by A.M.D.3, A.M.D.8, and the National Research Council.

Some of the findings have been incorporated in manuals of military instruction and training.

15. Intra-arterial Pentothal Injections

During the war sodium pentothal was used extensively as an intravenous anaesthetic. On several occasions there appeared in the literature reports of severe reactions as a result of accidental arterial injection. These reactions varied from severe pain in the limb and changes in skin temperature to actual gangrene. As a result of these reports A.M.D. 8 interested Dr. M.K. McPhail in the problem. An attempt was made to determine the mechanism and to find suitable methods of treatment.

Dr. McPhail attempted to produce gangrene in rats, cats, rabbits, dogs and monkeys with negative results. He therefore undertook to inject a small number of human volunteers. He found that injections of sodium pentothal into the radial artery elicited sharp pain when the barbiturate concentration was 3% or higher. Small alterations in tonicity or alkalinity of the pentothal solution did not appear to influence the pain reactions.

Examination of the literature indicates that there are two main types of reaction viz., (i) thrombosis and (2) irritation of tissue with pain and reflex effects. These are probably qualitatively similar and expressions of the same toxic effect. The explanation of the cause of these reactions is not apparent.

16. Blood Transfusion and Rh Sensitization

How research was developed by noting a relationship between two widely separated experiences is illustrated by the following example. Reports coming to A.M.D.8 from the #1 R.C.A.M.C. Research Unit in Italy pointed to the rather frequent occurrence of Jaundice in wounded troops. This led to the thought that such men would probably receive several transfusions of blood and might therefore become sensitized to the Rh factor. Serum from Dr. Diamond's laboratory in Boston was therefore despatched to Italy by air.

During the Italian campaign it was noted that many transfusion reactions occurred in men who received multiple transfusions. While it was appreciated that not all these reactions could be attributed to sensitization to the Rh factor it was felt that useful information might be obtained if the role of Rh sensitivity was investigated.

It had generally been stated that only 2 - 4% of Rh negative individuals were capable of forming anti-Rh agglutinins, and only after repeated transfusions. However a study of the literature showed that this estimate had been based largely on the incidence of erythroblastosis fetalis among Rh positive infants delivered by an Rh negative mother, and that no adequate study of blood transfusions had been made on a large scale.

It was therefore decided after discussions between Col. Hurst Brown and Dr. Louis K. Diamond of Boston, that a survey be made to establish the incidence of Rh sensitization amongst Rh negative men who had received one or more whole-blood transfusions without regard for Rh type, while serving overseas.

In June 1945, Capt. Joan Whittaker was sent to Boston to study the latest methods for testing anti-Rh agglutinins, and to discuss with Dr. Diamond practical methods for carrying out the survey.

It was decided that 1,000 men who had received blood transfusions should be typed for the Rh factor and that the serum of all Rh negative individuals of this group should be examined for anti-Rh agglutinins. Since large numbers of wounded men were in Veterans' hospitals at this time, permission was obtained through Dr. W.P. Warner of the Dept. of Veterans' Affairs for the research team to carry out work in D.V.A. and Military hospitals.

Between July and December 1945, Capt. Whittaker and Sgt. Ruth Kyle, C.W.A.C. visited Military and Veterans' hospitals in Montreal, Toronto, London, Ont., Winnipeg, Calgary, Edmonton and Vancouver. Each patient in these hospitals was asked whether he had ever received a whole blood transfusion; if the answer was in the affirmative he was Rh typed. Because overseas records were frequently unavailable it was necessary to rely on questioning the men. Blood serums from all Rh negative patients were tested for the presence of blocked and simple anti-Rh agglutinins. A small group of Rh positive men was also examined to determine whether they had been sensitized to the Rh factor, or other factors lacking in their own cells.

The survey showed that Rh sensitization had occurred in 40.6% of Rh negative men who had received whole blood transfusions. Moreover sensitization occurred as frequently after only one Rh positive transfusion, as after multiple transfusions. No instance of sensitization of Rh positive men to Rh negative blood was found. One patient, however, whose cells belonged to the Rh positive Rh' type had developed anti-bodies against positive cells of the Rh_o type.

This survey established the importance of administering none but Rh compatible bloods. Only by the Rh typing of all donors and recipients can haemolytic reactions be avoided in men who have received previous transfusions. The danger of sensitizing men by an initial transfusion can be prevented in this way too. The very high incidence of Rh sensitization after blood transfusion was a surprise to all. The findings of course have widespread implications as regards civilian practice.

17. Heparin and Fat Embolism

Early in 1945 reports from the No. 1 Mobile Research Laboratory indicated that traumatic fat embolism was being seen with some frequency in the Italian Theatre. Col. R.I. Harris, Col. Hurst Brown and Lt. Col. D.S. Mc Eachern became interested and considered it a problem requiring investigation. Knowing of Dr. C.B. Weld's interesting results with heparin and blood fat, it was decided that the Committee should support him in further studies. The aim was to try to determine the pathogenesis of fat embolism and the value of using intravenous heparin in its treatment. Prof. Weld had previously confirmed some work which showed that heparin in small doses could disperse intravascular fat globules resulting from alimentation of fat.

Dr. Weld with the assistance of Dr. M.I. Acker undertook this investigation at Dalhousie University. The results of their work to date are briefly summarized. There was no evidence that Perfrigen toxin would produce typical pulmonary fat embolism in guinea pigs, cats or dogs. Pulmonary fat embolism was produced by the intravenous injection of oil emulsions or of lipemic blood and even by the simple ingestion of oil. Heparin did not affect the lung pathology in these cases. Upon the evidence of their work they did not consider that heparin was of value in the treatment of pulmonary fat embolism.

18. Technical Advances in Surgery

a. Plastic Substitute for Paster of Paris Casts

Major A.M. Vineberg together with Mr. Rice and Mr. Brown of Canadian Industries Limited interested themselves in developing a cast with the use of plastic substitutes which would have definite advantages over the present plaster of Paris casts.

The work is still in progress and to date clinical trials have been few in number. However at the Seventh meeting of the Committee, Major Vineberg reported results with a new mixture of plaster of Paris and a plastic material. This mixture was a fine white powder which could be rubbed into crinoline bandages in the same manner as plaster of Paris and used in a similar manner.

The new mixture was found to have the following properties:

1. 50% stronger than plaster.
2. 10% lighter than plaster.
3. Did not contract or expand when setting.
4. Set within 12-15 minutes.
5. Non-toxic and non-irritating.
6. Non-friable.
7. More elastic than Plaster of Paris.
8. Cost approximately 10 cents per pound versus 2 cents per pound for plaster.

b. A Self stabilizing Triple-Grip Base for Crutches

Major A.M. Vineberg and Mr. Henry Bowen working at the Montreal Military Hospital at Ste. Anne de Bellevue, became interested in the inadequacy of ordinary crutches to provide suitable purchase on uneven ground, slopes and slippery surfaces. They therefore, developed a new tip. The result was a triple grip base with a ball and socket joint attaching it to the main body of the crutch. This new tip automatically adjusted itself so that no matter how the crutch was placed the three suction cups were at right angles to the ground. It also provided a larger weight bearing surface. This surface was stable and could not tip because of a lowered centre of gravity.

19. Psychiatric Problems

a. Civilian Readjustment of Neurotic Soldiers

In March of 1944 Col. J.D. Griffin applied for a grant-in-aid to make a survey of civilian readjustment of soldiers discharged because of psychoneurosis. It was estimated that from the beginning of hostilities until that time, some 15,000 men had been discharged from the Canadian Army with psychiatric disabilities of the psychoneurotic type.

In order to get an adequate cross-sectional sampling, over 500 ex-soldiers were interviewed including persons both from rural and urban areas, French and English speaking Canadians, and from varying financial and social strata.

The investigations were conducted by experienced social workers under the field direction of Capt. M.F. Henderson, R.C.A.M.C. and the general direction of Col. J.D. Griffin representing the Army and Dr. J.P.S. Cathcart representing the Department of Pensions and National Health. Maj. W.D. Ross also offered valuable assistance in this survey.

The appraisal of civilian readjustment was made by personal visits. In all cases an attempt was made to interview the man himself. Members of his immediate family were also interviewed and in many cases contact was made with his employer. An effort was made to gather all pertinent information concerning the status of his health, social and emotional adjustment prior to Army service. Special study was also made of any family patterns of illness or emotional instability. The Social Worker interviewed the family in an effort to get a detailed life history of the ex-soldier. Particular attention was paid to the incidence of neurotic traits in childhood, difficulties in school, extracurricular activities of the man, his work history, the interpersonal relationships in the home as well as his social interests and contacts outside the home. Similar detailed information was obtained with respect to his post discharge adjustment.

Generally speaking it appeared that individuals living in rural areas were making better adjustment than those living in cities.

Most were cases of neurosis of civilian origin. They should probably never have been admitted to the Army. Slightly less than half the men examined after discharge were feeling worse than before enlistment.

b. Adjustment of Women to Army Life

In the spring of 1944, Col. Griffin initiated an investigation of the personal adjustment of Canadian Women Army Corps personnel employed at National Defence Headquarters. Various facts indicated that the morale of these girls was low, and it was hoped that through this survey it would be possible to determine the chief causes of emotional stress and strain in order to bring forward constructive recommendations for improvement.

Capt. Margaret Stanford conducted this survey in which 135 Canadian Womens Army Corps and other ranks were interviewed. At least one representative was interviewed from every Directorate and Unit in Ottawa.

The general conclusions arrived at from this investigations are listed below:

1. The majority of C.W.A.C. in Ottawa were satisfied with their employment conditions.
2. There was discontent in the C.W.A.C. due to the fact that their loyalty was split between the Employing Directorate and the C.W.A.C. Administrative Unit.
3. There was not enough contact between the C.W.A.C. Officers and the employing officers. When this was the case, the responsibility of the Platoon Officer became limited to the small details of the domestic life of the Volunteer.

4. Women missed the amenities of a normal home, e.g., curtained windows, bed spread, attractive dining rooms, etc.

5. There was a lack of understanding on the part of the public. Service men sometimes were guilty of spreading stories about the C.W.A.C. It was decided that Civilian women who lived a sheltered life could not understand how other women could live as soldiers and not lose their femininity and social prestige.

c. Psychological Test Procedures

An investigation was started by Maj. W.D. Ross to try to assess the value of certain psychological tests in Army work, particularly their value in screening.

The Thematic Apperception Test, the Rorschach Technique and the Bellevue Wechsler Scale were used. Subjects consisted of thirty individuals considered to be definitely psychoneurotic, and thirty-seven individuals considered to have no psychiatric disabilities.

Capt. J.G. Sheps, R.C.A.M.C. was responsible for most of the work in this investigation. The tests were used in an abbreviated form and scored in a simplified manner by relatively untrained personnel.

The result of this work indicated that the tests when used in this manner appeared to have little value in the detection of psychiatric disorders at the recruit level.

During the Spring and Summer of 1945 Capt. F.C.R. Chalke, R.C.A.M.C., undertook a study of the Harrower-Erickson Stress Tolerance Test in an attempt to check its validity as well as its application to problems of military psychology. His subjects consisted of Officer Candidates at Brockville, psychotic and psychoneurotic patients in the D.V.A. Hospital at Ste. Anne de Bellevue and psychoneurotic patients at the D.V.A. Neurosis Treatment Centre, Toronto.

In summary this work indicated that the test was of value in screening persons susceptible to specific disturbing situations.

20. Entomological Projects

(a) Plague Survey 1943

Ground squirrels infected with sylvatic fever were found in the Suffield Experimental Station area in 1942. This was considered to constitute a threat to the health of troops in training or stationed in the area. It was therefore thought advisable to survey the extent and prevalence of infection. Since the disease was known to be endemic in ground squirrels in the Youngstown-Hanna area and since infected ground squirrels had been taken just south of the Saskatchewan border, it was felt that the survey should include military establishments and P.O.W. camps from Winnipeg to the Rocky Mountains. (The Grand Prairie Training Centre was considered too remote from infected areas to be included in the survey.)

Major R.H. Ozburn was detailed to organize and supervise the survey.

The survey was to include some 20 military establishments scattered through a large area and it was deemed necessary to organize on the basis of three crews. Each crew consisted of a veterinarian, assisted by a trained biologist, and was supplied with a 15 cwt. 4 x 4 Ford personnel carrier equipped as a mobile laboratory complete with qualified driver. Lt. N.A. Hitchman was detailed to supervise field work during the survey. Crews were given ten days' preliminary training in the Medicine Hat and Hanna areas. During this period, Mr. J.H. Brown of the University of Alberta, who had had experience with the Alberta Plague Survey crews, assisted.

The area within a five mile radius of each selected establishment was surveyed by making systematic collections of ground squirrels, rodents and other small animals. Collections were made by trapping or shooting. Each animal was identified as to species and it's body was placed in a paper

PLAGUE SURVEY - MOBILE LABORATORY IN THE FIELD.

bag which was labelled in code so that the exact location where each animal was collected could later be determined. All ectoparasites were removed from the animals and place in vials of saline. Each animal was then autopsied. Whenever macroscopic evidence of disease was found, tissue specimens were placed in vials of preservative. Parasites and tissue specimens were sent daily to the Public Health Laboratory at Kamloops where inoculation tests were conducted.

During the survey more than 4,000 ground squirrels were taken and autopsied. Of these over 500 showed lesions suggestive of plague and warranting the dispatch of tissue samples to the laboratory. Over 700 other animals were taken, of which 130 showed macroscopic indications of disease. Over 7,100 fleas representing 11 species were collected from the animals. Three of the 11 species of fleas found in 85 of the 101 collections were known to be plague vectors.

No animal or parasite taken during the survey was shown by laboratory inoculation tests to be infected with plague bacilli. The personnel at the Kamloops Laboratory thought, however, that some of the negative results might have been due to the delay between mailing and receipt of the specimens. This was in some cases sufficient to result in the death of the plague organism.

The survey did show that Tularaemia, previously known to be endemic in the southern part of Military District 13, was present in animals in the area from Edmonton to Calgary. Positive results were obtained from inoculation tests with tissue specimens from Franklin's gull, one species of ground squirrel, 2 species of mice and one species of rabbit tick. This is the first record of Tularaemia-infected gulls.

Tissue specimens from ground squirrels of the Dundurn area were sent to the Veterinary Laboratory, University of Saskatchewan and were shown to be positive for Pasteurella septica, the causal organism of haemorrhagic septicemia.

(b) Head Lice

During the winter of 1942-43 the incidence of head lice at No. 2 Basic Training Centre, Canadian Womens' Army Corps, Kitchener, Ontario, increased at an alarming rate. A large percentage of the infected personnel arriving at the training centre were from east of the Ottawa River. The 'lotio pediculosis' then on issue for the treatment of head lice had been shown to be inefficient and at the request of A.M.D. 5 (Hygiene and Preventive Medicine), Maj. Ozburn was assigned to conduct tests of other lousicide materials in order to obtain an efficient, easily-applied remedy for head lice.

A number of promising insecticidal materials including pyrethrin, Lethane and Thanite, were tried in different lotions made up with a base of Deobase or Pensoline (deodorized kerosenes). The tests showed that of the materials tried, 7% Thanite applied in Deobase was most effective in killing both lice and their nits, with a minimum of irritation to the skin. This material was rubbed into the hair until the scalp was moistened. It was left for half an hour and then rinsed out. As well as being a good lousicide this formula apparently was also an efficient remedy for dandruff, and was adopted by A.M.D. 5 as a modified 'lotio pediculosis'.

(c) Disinfesting of Stores

In the fall of 1943, at the request of Returned Stores Section, Royal Canadian Ordnance Corps, Maj. Ozburn proceeded to Aurora, Ontario to test the efficiency of the disinfestation vault then in use. This was considered advisable before similar vaults were installed at all Returned Stores Depots in Canada. This was not the Orr Hut but a special installation designed for the purpose.

Tests were conducted by placing insects, in special containers, amongst the stores during a 'routine' disinfestation. This showed that no kill was being obtained. Such disinfestation was merely a waste of time and money. A report was submitted recommending certain changes in the vault and in the procedure. Further tests after the recommendations were supposed to have been carried out, showed that a 30% kill was being obtained and that the change from Cyanogen Chloride to Cyanogas had introduced a hazard to personnel handling disinfested stores. The stores in the disinfestor, as shown by test papers, contained 75 to 100 parts per million HCN absorbed in the material. As a result it was decided to change disinfestation procedure from poison gas to the use of hot air. The Ottawa disinfestation vault was used as a pilot model.

Delays were encountered in making structural changes. DDT then became available. This eliminated the need for disinfestation.

In the spring of 1943, it was recognized that there was a fire hazard associated with the Millbank Disinfestor, then commonly used in England. D.G.M.S. suggested that an obsolete Stores lorry, of which a number were available in Canada, be changed into a mobile disinfestor. It was estimated that this unit could handle approximately 100 battle dress or blankets at a time, and that it would always be ready without assembling or dismantling.

Construction of the pilot model was undertaken by the Department of Munitions & Supply. The pilot model was not ready for final tests until just before V-E Day. By the time it was completed at a cost of several times the original estimate, the need was eliminated by the adoption of DDT.

(d) Insect Repellents

Insect repellents available in the spring of 1943 did not afford protection against mosquitoes for more than twenty minutes to half an hour. Trials of newer insecticides which promised more lasting effects were undertaken.

Comparative tests, were conducted at Dundurn, Sask., Monteith, Ontario and Maniwaki, Quebec. These tests included the standard army mosquito lotion and mosquito cream, dimethyl phthalate, Indalone, and Rutgers 612, alone and in combination with other materials. Some of the materials tested were provided by the U.S. Department of Agriculture Laboratory at Orlando, Fla. Some were supplied by the Department of Agriculture, Division of Entomology, Ottawa. Some were prepared at the Central Medical Stores, Ottawa.

These tests showed that protection-times from various materials and combinations varied from 20 minutes for the army mosquito lotion, and 50 minutes for the army mosquito cream, to over 5 hours for dimethyl phthalate in certain combinations with other inert materials. As a result of these tests, A.M.D.5, (Hygiene and Preventive Medicine), recommended that dimethyl phthalate in castor oil be issued to the troops as an insect repellent.

The insect repellent tests started in 1943 by the Research Division were taken over and continued by the Directorate of Research in 1944. The 1944 tests against mosquitoes and black flies were conducted in Labrador and Newfoundland.

(e) Mosquito Survey

Years ago malaria was endemic in certain parts of Canada, by 1943 infected service personnel were returning from overseas areas where malaria

Mosquito Survey - Stagnant water near Chorley Park Military Hospital, Toronto - an ideal breeding ground for mosquitoes.

was endemic. It was considered by representatives of the Medical Service of the Army, Navy, Airforce and the Department of Pensions & National Health that some attention should be paid to the possible reintroduction of malaria into Canada. At a meeting between medical representatives of the Services and the Department of Pensions & National Health with entomologists of the Department of Agriculture, it was concluded that the available knowledge of the distribution and prevalence of Anopheline mosquitoes in Canada left much to be desired. It was deemed advisable that a survey be conducted to determine the prevalence of Canadian species of Anophelines which might serve as vectors for malaria. The Division of Entomology, Department of Agriculture, undertook to have their field personnel conduct ground surveys near selected hospitals or other establishments where personnel returning from overseas were stationed. These ground surveys were to pay particular attention to breeding areas, and to resting places of the adult mosquitoes. The Services undertook to set up mosquito traps in each of the selected institutions, to look after the operation of the traps, and to have all mosquito specimens turned over to the Department of Agriculture for identification. The Services portion of the survey was under the direction of Maj. R.H. Ozburn.

In 1944 traps were set up at 30 selected Service establishments extending from Sydney, N.S. to Patricia Bay, B.C. In 1945, 45 traps were operated. In both 1944 and 1945 four species of Anophelines *Anopheles punctipennis*, *Anopheles maculipennie occidentalis*, *Anopheles walkerii*, and *Anopheles quadrimaculatis*, were taken. *A. punctipennis* was taken in the area from New Brunswick to Saskatchewan; *A. maculipennis occidentalis* from New Brunswick to Alberta; *A. quadrimaculatis* in the Ottawa-Kingston-Peterboro area; *A. walkerii* in Quebec and Ontario. The A. quadrimaculatis is the important malaria vector in the United States. A. walkerii is a possible vector. From the survey it was evident that these mosquitoes, the most likely species to serve as vectors of malaria in Canada, form but a negligible portion of the mosquito population in areas where they occur and that therefore the threat of malaria is of no great concern in Canada.

21. Miscellaneous Activities

It is quite impossible to discuss all the varied activities of the Research Division and of the Army Committee. A glance down the list of titles of reports given in Appendix G will indicate the broad interests that were covered. In many instances A.M.D. 8 was merely the initiator of a plan or idea which was later carried to successful conclusion by others. Thus, the incentive for the Army's programme for procuring penicillin on a large scale sprang largely from the Research Division. Similarly, a representative of A.M.D.8 attended as medical advisor, all meetings of the Dress and Clothing Committee of the Ordnance Branch. There many decisions were made which affected the health and comfort of several hundred-thousand of our troops. Some activities seemed almost routine. The extensive trial of stretchers, carried out by the R.C.A.M.C. Training Centre at Camp Borden, was initiated by the Research Division. During this splendidly run trial a variety of American and British stretchers were tested against the Canadian General Issue stretcher, and a great deal of information was obtained on the durability and design of stretchers. As a result, a submission was made to Ordnance that for future purchases the Canadian General Issue stretcher be considered obsolete, and that a light-weight model be issued instead. Other projects turned out to be merely precautionary. Under the direction of Dr. G.A. Ledingham of the National Research Council, Ottawa, extensive tests were carried out

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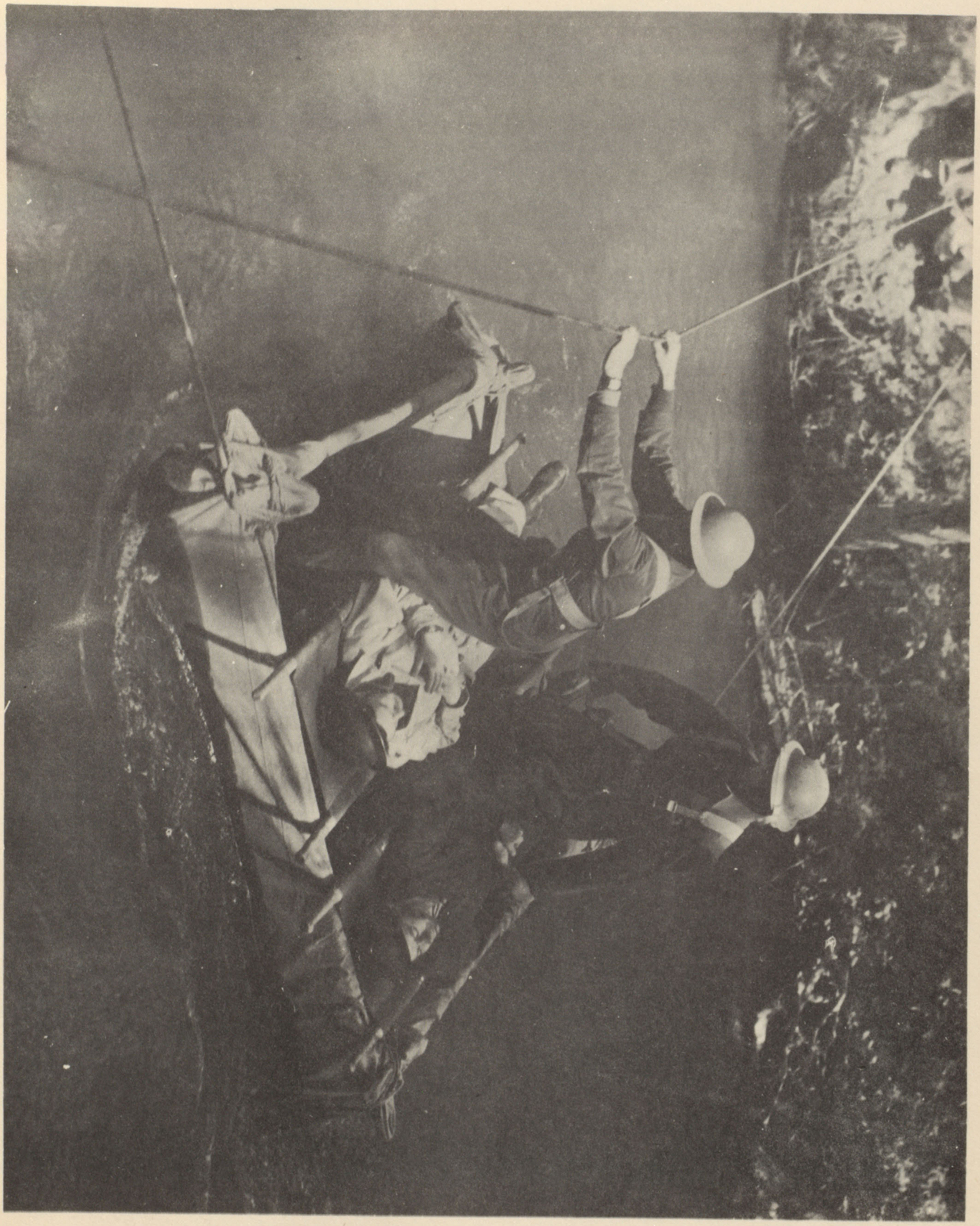


Fig. 7. STRETCHER TRIALS. River crossing by standard stretcher boat, Camp Borden.

Blood Coagulation Test - Capt. D.W. Ruddick carrying out test.

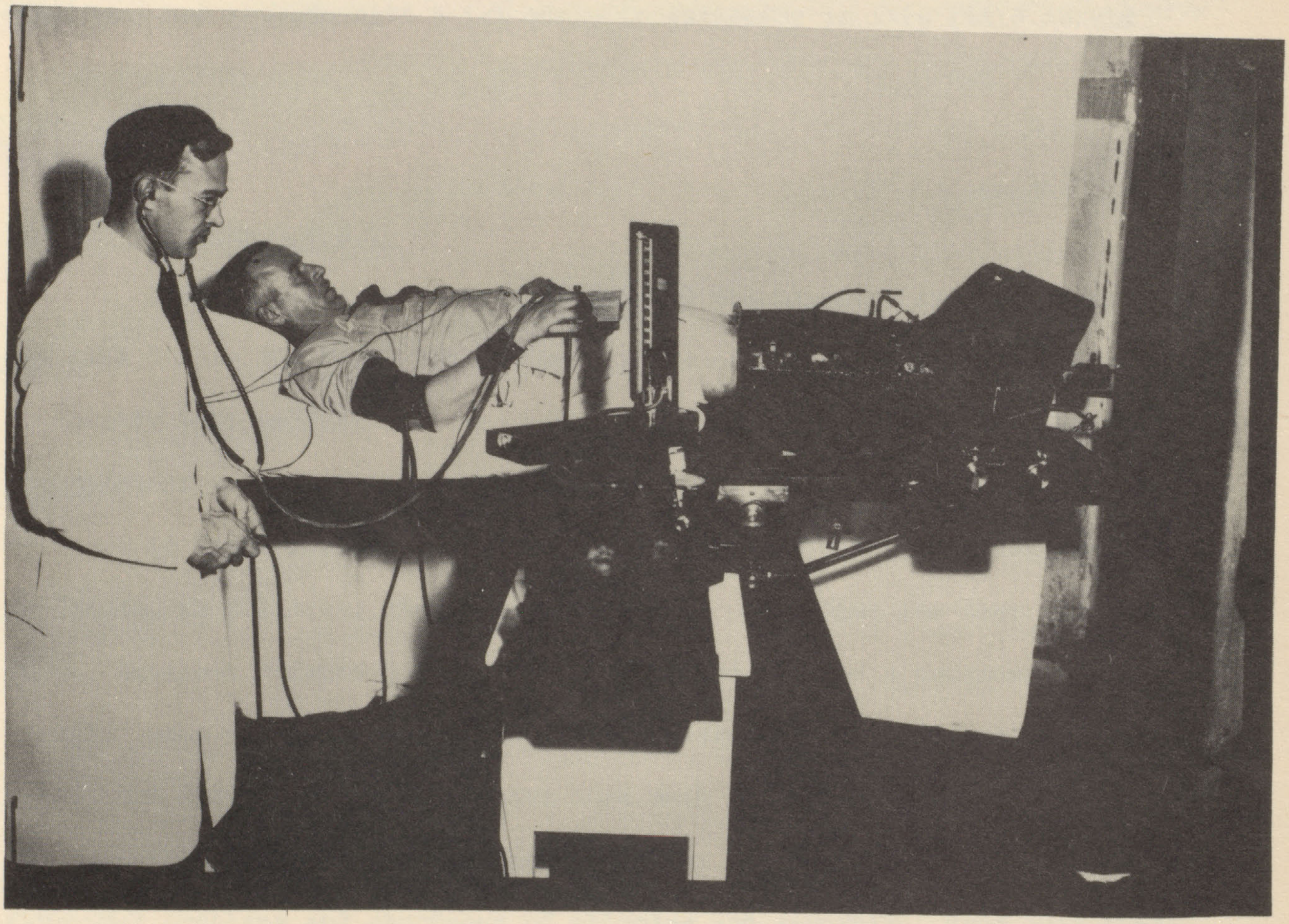
in the tropical chamber on the durability of various medical stores, field panniers and other items of equipment. It was known that rapid growth of fungi, and the moist heat in the South Pacific Area might cause rapid decay of medical equipment. The tests showed which medical stores were likely to go bad, and plans were laid to remedy the situation if necessary. Fortunately, with the collapse of Japan, there was no further need to move medical stores to tropical climates and the work therefore stands as an item of good insurance.

There were lighter sides too. In order to test out mud shoes designed by Dr. R.L. Noble, it was necessary to truck several loads of mud into the field-house on the McGill University campus. There the observers wallowed in mud to their hearts' content. It cost $40.00 to have the mud moved out. Later, Army officers were to be seen navigating merrily on the mud flats near New London, Connecticut. A.M.D. 8 also was often given the task of exploring some new suggestion or "Question Box" invention. Some of these were patently "screw-ball" ideas; other could be seen to have possibilities. The officers of A.M.D. 8 adopted the attitude that they should always make every effort to put these ideas to test. Thus, a letter from a Winnipeg engineer, who had lived in the Orient, carried a claim that grapefruit seeds were a high source of quinine. No information could be obtained on this point from the literature or from the Department of Horticulture. Owing to the world scarcity of quinine at that time, it was considered necessary to test the claim. Arrangements were therefore made with the Chateau Laurier Hotel in Ottawa to collect all grapefruit seeds over a period of two weeks. This provided several buckets full which were then taken to the Dominion Analyst. The seeds were found to contain no quinine.

An invention which it was not thought necessary to submit to field trial was claimed to enable a man to march at a rate of 18 miles per hour. The device consisted of a series of springs in the soles of army boots. These acted like a pogo stick and were supposed to bounce the man through the air in great leaps. The invention was entitled "The Human Jack-Rabbit".

Early in 1945 the Chemical Warfare Laboratory drew to the attention of A.M.D. 8 a curious skin reaction to adhesive tape. This occurred in 50 volunteers who were being skin tested against chemical warfare materials, but who reacted even more to the adhesive used for fixing the test patches in place. Examination showed that this adhesive had a grey adhesive mass as compared to the creamy yellow of previous adhesive. The new adhesive was traced to Central Medical Stores who were able to give the number and disposition of various batches produced under this contract. Further detective work showed that the reaction was due to the inclusion of reclaimed rubber instead of natural or synthetic rubber in the formula. This change had been made by the manufacturer as a result of restrictions on raw rubber placed by the Rubber controller. A D.G.M.S. circular letter was prepared at once giving the necessary warning to all medical establishments in Canada, with suggestion on how to deal with the matter. Negotiations were then made with the Rubber Controller, who agreed to release a supply of raw rubber to meet the needs for adhesive. Such precautionary work was frequently undertaken by the Research Division. It was often not very exciting, but it contributed to the high level of care provided by the medical services.

Dr. T.C. Waugh and Capt. D. Ruddick initiated an important piece of work at the Department of Pathology, Royal Victoria Hospital, Montreal. They developed a titration method for the measurement of blood coagulability. This test won great interest when presented to the American Society for Clinical



POSTURAL BLOOD-PRESSURE REACTIONS.

DR. HAROLD RICE WITH SPECIAL APPARATUS APPLIED TO PATIENT'S LEGS,

WINNIPEG GENERAL HOSPITAL.

Investigation in Atlantic City, May 1944. Another fundamental investigation was carried out by Dr. Harold Rice in Winnipeg with the Assistance of Capt. E.T. Feldsted. They studied postural adjustments of the vascular system and developed new methods with which every investigator in this field should become familiar.

LIAISON

1. Liaison with C.M.H.Q.

Medical contacts between Ottawa and the Canadian Army overseas were not good during the first two or three years of the war. It was remarked frequently that medical officers both in the field and at Canadian Military Headquarters seemed to have grown away from Canada. They had built up new interest in Great Britain and showed little interest in medical happenings in Canada, in political changes, or in things other than the home and loved ones. National Defence Headquarters was looked upon as a necessary evil or perhaps, even as unnecessary. An active interchange of officers between Canada and Great Britain would have done much to prevent this attitude. During the early years of the war, however, this exchange was difficult due to man-power problems and shortages of shipping and aircraft. From 1943 there was an increasing interchange of men especially of staff officers, and the benefits were seen at once.

Extended visits to the Canadian Army overseas were made at various times by several officers from A.M.D.8. These included Col. Hurst Brown, Lt. Col. D.S. McEachern, Maj. A.J. Cipriani and Lt. Col. J.L. Blaisdell. Through the co-operation and hospitality of Major-General Robert Luton, D.M.S., C.M.H.Q., they were given an opportunity to study medical formations and to visit research centres throughout Great Britain. They gained a new understanding of problems of the Army overseas, and returned to Canada with many new ideas. Conversely, a number of officers returned to Canada from overseas for visits. Those with a particular interest in A.M.D.8 included the following: Brigadier J. MacFarlane, (Consulting Surgeon), Col. Milton H. Brown, (Director of Hygiene, C.M.H.Q.), Lt. Col. A.L. Chute, (O.C. No. 1 Canadian Research Unit), Major E.H. Bensley, (Nutritional Advisor, Canadian Army Overseas) and Lt. Col. C.A.R. Gordon (Advisor on Chemical Warfare to D.M.S., C.M.H.Q.). As a result of these visits, ideas were exchanged and much closer co-operation existed thereafter between the Research Division at National Defence Headquarters and medical activities at C.M.H.Q.

In 1944 a mechanism was set up to get medical reports back from overseas for the three services. This was organized by Canadian Medical Intelligence Division. Major M.M. MacFarlane was placed in charge of the office at D.M.S., C.M.H.Q. Reports and documents were photostated in London and the films were flown across the Atlantic. The films were then enlarged and printed in the office of C.M.I.D. in Ottawa, which was organized by the R.C.N. and manned by an R.C.N. medical officer and navy personnel. The reports were then distributed to the Medical Directors of the three services. Much valuable material was received from this source but there was never the same intimate interchange of information as obtained with the United States.

Perhaps the closest contact of A.M.D.8 was with the nutrition group at C.M.H.Q. who worked under the direction of Maj. E.H. Bensley. Maj. Bensley did an excellent job of getting proper standards of messing implemented in the Canadian Army overseas. With the assistance of Maj. J.A.F. Stephenson he was responsible for introducing the programme of high protein milk-shakes into the overseas hospitals. He was also, along with Maj. R.P. Howard, able to carry out a number of field trials and other investigations. In all, seven reports on nutritional subjects from the group at C.M.H.Q. were published in the Proceedings of the Army Committee.

2. Liaison with No. 1 Research Laboratory, R.C.A.M.C.

This excellent mobile research laboratory was conceived and organized at C.M.H.Q. through the efforts of Brigadier J. MacFarlane. From the time it first began rolling in Great Britain, through its field work in Italy, and until the time it was moved to Western Europe near the end of the war, there was the closest co-operation between this unit and the Research Division at National Defence Headquarters. The Proceedings of the Army Committee and other relevant reports were sent to the unit as speedily as possible upon their publication. Requests from the Unit for special information, for books, or for special apparatus or chemicals, were made to A.M.D.8 by cable or airmail. When material was assembled it was flown to the Unit by bomber mail. Thus, through the Associate Committee on Army Medical Research, it was possible to supply the Unit quickly with equipment not ordinarily available through Army channels. In this way, a valuable moving picture camera was provided, and colour film was sent over at intervals. Apparatus, such as photo-electric colourimeters, special glass equipment, rare chemicals, Rh factor blood testing sera and other items were sent over. Conversely, the Unit, through its able Commanding Officer, Lt. Col. A.L. Chute, sent reports of its activities to A.M.D.8 in Ottawa, as well as to the D.M.S., C.M.H.Q. The Associate Committee on Army Medical Research had the privilege of publishing the reports of the Unit in its Proceedings. This permitted the work of the Unit to reach a large and influential audience without delay. The reports were particularly appreciated in the United States. By the autumn of 1945, 36 reports on such subjects as Blood Preservation, Treatment of Shock, Infections in War Wounds, etc., had appeared and many more were to come. The relationship between the Unit, the Army Committee and A.M.D.8 was an ideal one and contributed much to all concerned.

3. R.C.A.M.C. Liaison Office, Washington

Soon after the Research Division came into existence it was realized that plans would have to be laid for closer liaison with the United States and Great Britain on medical matters. At the time there was some contact with activities in Great Britain, through the Director of Medical Services, C.M.H.Q. In Washington, however, there was no Medical Representative and Medical Liaison was carried out by non-professional officers of the Canadian Joint Staff Mission. This work was shouldered willingly, but it was obvious that a more professional and scientific contact was necessary. A submission was therefore made by A.M.D.8 for the setting up of a Liaison Office for medical activities in Washington.

A distinguished Canadian Scientist, Dr. J.B. Collip, was chosen to head this mission. With the rank of Lieutenant Colonel and later Colonel, he undertook to organize and supervise the office. Under the Army arrangement for part time employment (G.O. 139), he made periodic visits to Washington, and in the intervening time carried out his onerous duties as Chairman of the Associate Committee on Medical Research of the National Research Council, Canada. As full time Liaison Officer in Washington, Major A.H. Neufeld was chosen, and this proved to be a most happy selection. He arrived in Washington on the 28th October, 1943, on Command. A place was later made for him on the establishment of the Canadian Army Staff, Washington, and he was posted to it on 24th January 1944. The Canadian Army Staff, and Washington Branch of the Department of Munitions and Supplies, were most helpful in establishing an office. The Canadian Joint Staff Commission Building, at 2222 "S" Street, N.W., was fully occupied. The Department of Munitions and Supply at 1205 15th

Street, N.W., however, kindly made office space available and supplied the necessary office equipment and the services of a secretary. Through Col. Collip's wide contacts and his supervision, and through the energy and personality of Maj. Neufeld, the office soon became a model of medical "facilitation". Documents and reports from a host of American agencies, both civilian and service, were soon pouring into Ottawa. Numerous requests were made from Ottawa for specific information. This was obtained at once from the responsible American authority in Washington, and the answer sent by teletype. Samples of medical equipment, drugs, field medical panniers, stretchers, jungle equipment, etc., were forwarded to Ottawa. Soon all other branches of the Medical Directorate were using the Liaison Office for their needs.

The R.C.A.M.C. Liaison letters were unique. These were detailed and interesting documents, covering subjects which Maj. Neufeld saw to be of coming importance. Information was assembled from all sides and written up in a well digested letter.

Major Neufeld saw early that one of the most important bases for successful liaison work lay in reciprocity. He early begged for reports of Canadian activities and it was not long before reports from the Army Committee and other N.R.C. Committees were flowing to him in good volume. He pointed out that it did not matter how much material was exchanged with others but that success lay in the goodwill and feeling of reciprocity engendered by any exchange of material. Maj. Neufeld was so successful that on 25th August, 1944, at the invitation of the Surgeon General, U.S. Army, the R.C.A.M.C. Liaison Office was moved to the building occupied by the Surgeon General at 1818 "H" Street, N.W. Maj. Neufeld and his staff remained there working side by side with the Surgeon General's staff until the end of the war.

The establishment of successful liaison with the various U.S. agencies, service as well as civilian, was due to the whole-hearted co-operation of our American neighbors. In this brief review it is not possible to list all agencies. It may be appropriate, however, to name those that were largely responsible for the close and friendly relations. No attempt will be made to list individuals.

War Department

Office of the Surgeon General, including Epidemiological Board, Typhus Commission, and Army Medical Installations in Z1.

The ground Surgeon, Army Ground Forces.
The Air Surgeon, Army Air Forces.
Commonwealth Section, Military Intelligence Service.
Special Service Division, ASF.
Personal Affairs Division, ASF.

U.S. Navy

Bureau of Medicine & Surgery, including Navy & Marine Corps Medical Installations in Z1.

United States Public Health Service

National Institute of Health.
Cancer Research Institute.

National Research Council

Division of Medical Sciences.
Committee on Medical Research (CMR).
Medical Directorate, Selective Service System.
Medical Directorate, Veterans' Administration.
Bureau of Standards.
Liaison Officers, British, Australian, South African, etc.,

At the war's end the R.C.A.M.C. Liaison Office had prepared and submitted to D.G.M.S. and other interested Directorates and Organizations in Canada, 148 R.C.A.M.C. Liaison Letters (Washington) 39 R.C.A.M.C. Film Reports (Washington) and 12 Special R.C.A.M.C. Reports. In addition, all issues of pertinent U.S. publications were submitted to D.G.M.S. Some of these follow:

(1) U.S. Army Medical Department Bulletins.
(2) Medical Bulletin, Office of the Chief Surgeon, etc.
(3) Technical Bulletins Medical.
(4) Reports, Armoured Medical Research Laboratory.
(5) Weekly Health Reports, U.S. Army.
(6) Monthly Status Reports, SGO.
(7) Essential Technical Medical Data, Overseas Theatres.
(8) U.S. Army M.D. Specifications.
(9) Medical Reports on Morale and Psychiatry.
(10) Minutes, M.D. Technical Committee.
(11) Annual Reports, U.S. Army Epidemiological Board.
(12) Reports on Captured Enemy Medical Equipment.
(13) Reconditioning News Letter.
(14) Bumed News Letter.
(15) U.S. Naval Medical Bulletin.
(16) Hospital Corps Quarterly.
(17) Reports, Naval Medical Research Institute.
(18) Reports, Medical Field Research Laboratory.
(19) Reports, School of Aviation Medicine.
(20) Air Surgeon's Bulletins.
(21) AAF Information Letter.
(22) AAF Rheumatic Fever Control Programme News Letter.
(23) ASF Monthly Progress Reports "Health".
(24) ASF Monthly Progress Reports "Information & Education".
(25) Reprints, Josiah Macy, Jr. Foundation.
(26) Digest of Neurology and Psychiatry, Institute of Living.
(27) Reports, Army-Navy-OSRD Vision Committee.
(28) Reports, OSRD Insect Control Committee.
(29) Annual Reports from various U.S. Service and Civilian Organizations,

The Liaison Office served D.G.M.S. and numerous other Canadian organizations and individuals in special ways when asked to do so. All requests were given prompt attention. In answer to a written question about liaison work Maj. Neufeld wrote the following: "A great many factors are involved in the establishment of successful liaison. Insofar as the Washington Office is concerned it was found that freedom of action on the part of the liaison officer, personal contacts and reciprocity in large part determined success.

"To have freedom of action the liaison officer must have the full confidence of all his superiors. Administrative detail must be reduced to the absolute minumum.

"It has been my experience that no amount of reading can accomplish as much as personal contact. It is essential to know all organizational details of the Agencies with whom liaison is to be established. Knowing this, one can readily identify key personnel and every effort must then be made to gain their confidence. Without exception, in my experience, they were most friendly and co-operative. In Washington we found the meetings and conferences sponsored by the Division of Medical Sciences of the National Research Council most useful for establishing personal contact with service and civilian people, all top men in their fields.

"Reciprocity in liaison is quite as essential as in any other field. Liaison is a give and take proposition. Therefore a liaison officer must be thoroughly familiar with the home product. It is interesting to note that throughout my stay our office was looked upon by U.S. Agencies as representing all the Medical Services of Canada rather than the Canadian Army. The importance of frequent visits to Canada can not be over-emphasized.

"Throughout my stay in Washington and particularly since the end of the war, various U.S. Organizations and individuals have expressed keen interest in post war scientific co-operation with Canada. This would be achieved, possibly, using channels developed during the war. Canada has much to gain through such co-operation. It is recommended strongly that the maintenance of a permanent Liaison Establishment be given serious consideration. This could serve not only the Department of National Defence, but also the Department of Veterans' Affairs, the Department of Health and Welfare, the Medical Committees of the N.R.C. (Canada) and others that might show interest." Such post-war plans are still a matter for discussion and debate.

POST-WAR MEDICAL RESEARCH

Many wartime committees of the N.R.C. were folding up by the end of

1945. The Army Committee continued to function, however, at the request of President C.J. Mackenzie, who felt that this agency should remain active until Post-War plans for Army Research were more clearly drawn. The activities of A.M.D.8 and the Committee were, nevertheless, gradually curtailed and the staff greatly reduced. In the fall of 1945 Lt. Col. R.M. Kark, recently returned from Burma, replaced Lt. Col. D.S. McEachern as D.A.D.M.S. of A.M.D.8. The latter returned to teaching duties at McGill University. Capt. E.O. Hughes also went to a teaching post and was replaced as executive officer by Capt. D.M. Bell. Col. W. Hurst Brown continued to lead the division and to preside over the Committee. This officer, in addition to organizing activities from the beginning, gave dynamic leadership throughout the war to A.M.D.8 and the Army Committee.

Col. Brown left full-time service in March 1946. He had arranged for Maj. Jack Crawford, a Veteran of Hong-Kong, to take his place as Director of the Research and Development Division of D.G.M.S. The stage was left to this fine Officer with confidence that he would fill it well in the difficult days ahead.

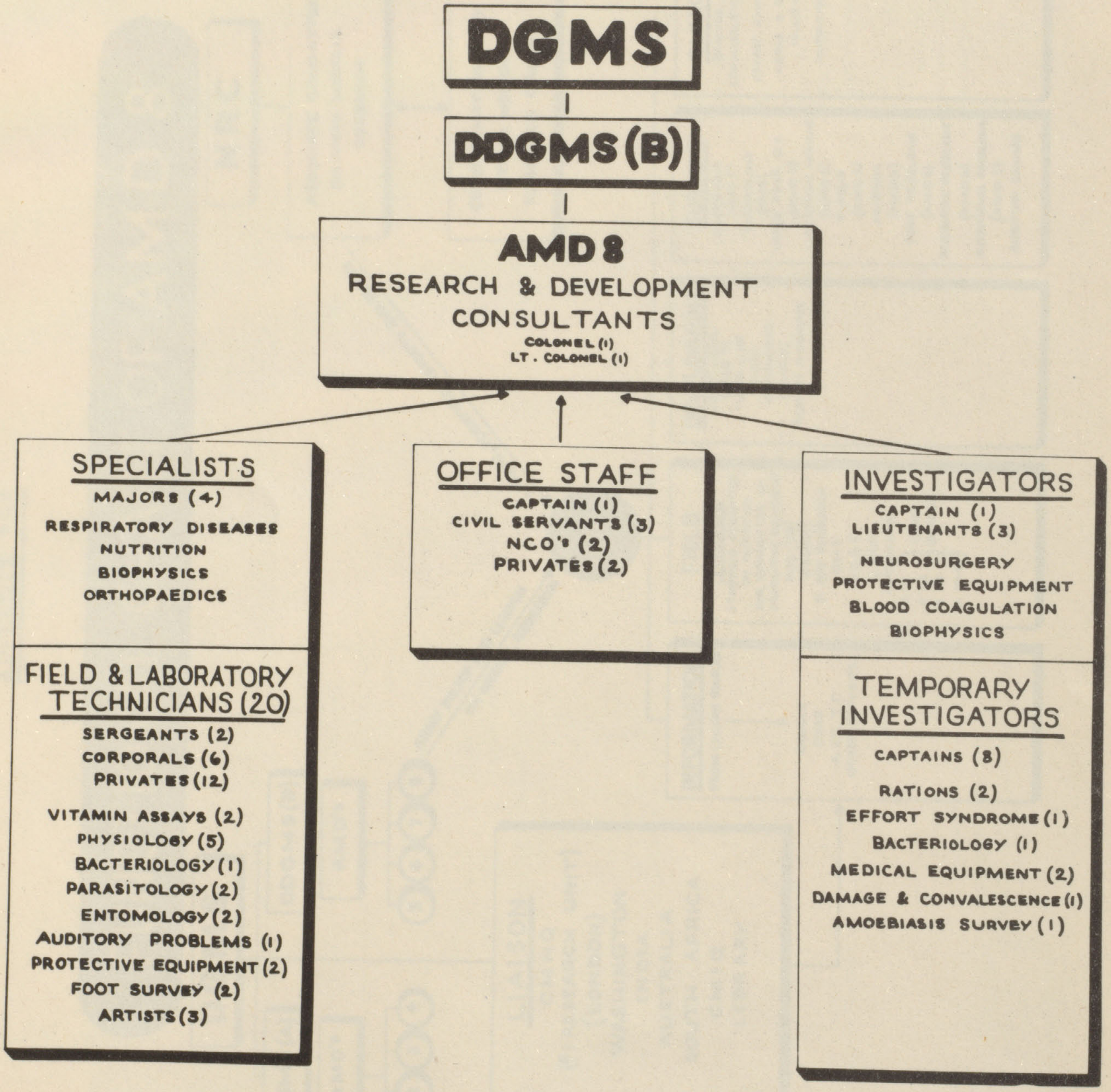
Two of the greatest lessons arising from the work of A.M.D.8 and the Army Committee, deserve especial emphasis.

First:- Close connection with the National Research Council was invaluable in a Myriad Ways.

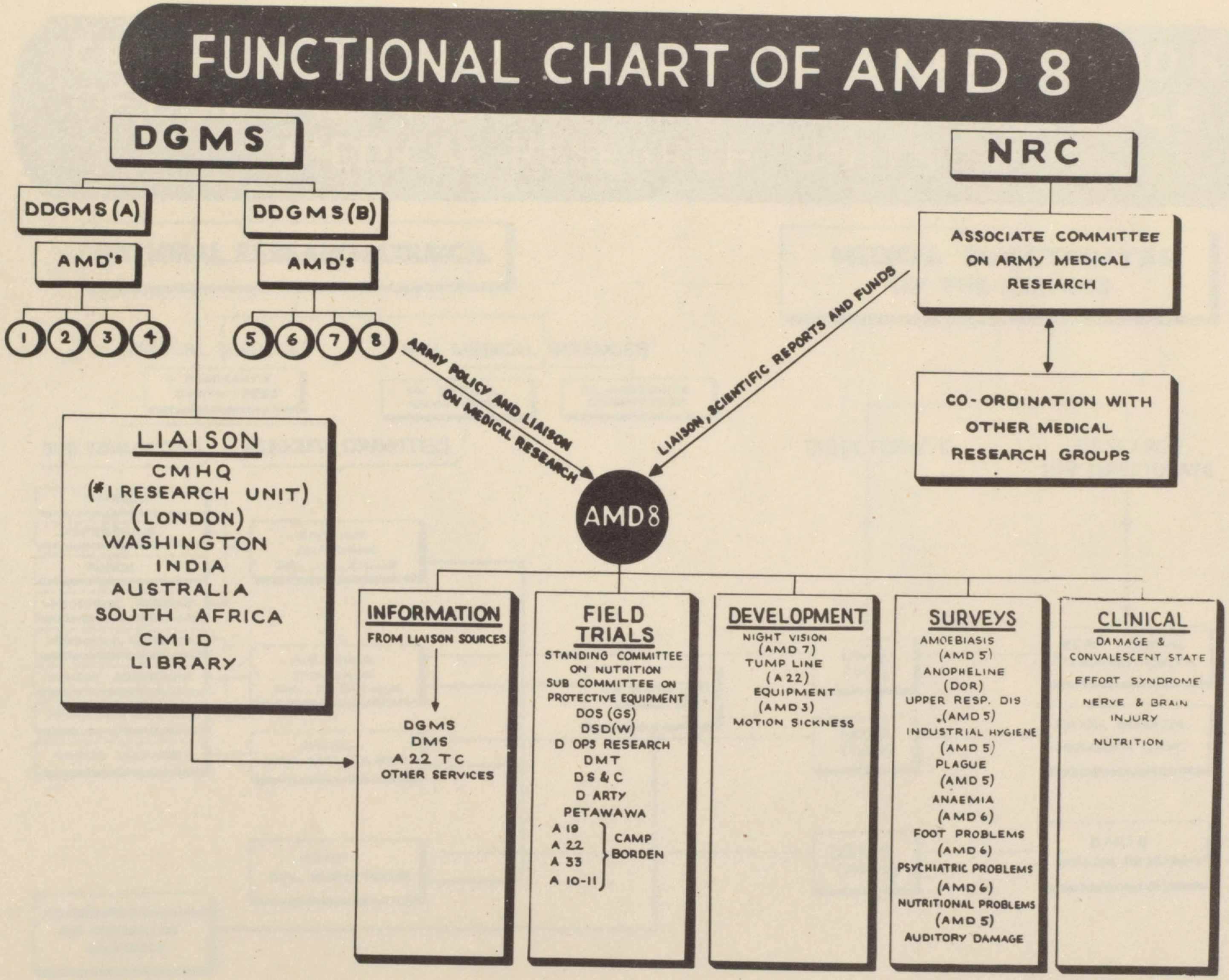
Second:- The Chairman of the Committee and his Deputy were Army Officers and could thus make every effort to drive-through and implement the recommendations of the Committee.

Many activities described above resulted from the acute pressure of

APPENDIX "AA"


DGMS
DDGMS (B)
AMD 8
RESEARCH & DEVELOPMENT
CONSULTANTS
COLONEL (1)
LT. COLONEL (1)
SPECIALISTS
MAJORS (4)
RESPIRATORY DISEASES
NUTRITION
BIOPHYSICS
ORTHOPAEDICS
FIELD & LABORATORY TECHNICIANS (20)
SERGEANTS (2)
CORPORALS (6)
PRIVATES (12)
VITAMIN ASSAYS (2)
PHYSIOLOGY (5)
BACTERIOLOGY (1)
PARASITOLOGY (2)
ENTOMOLOGY (2)
AUDITORY PROBLEMS (1)
PROTECTIVE EQUIPMENT (2)
FOOT SURVEY (2)
ARTISTS (3)
OFFICE STAFF
CAPTAIN (1)
CIVIL SERVANTS (3)
NCO's (2)
PRIVATES (2)
INVESTIGATORS
CAPTAIN (1)
LIEUTENANTS (3)
NEUROSURGERY
PROTECTIVE EQUIPMENT
BLOOD COAGULATION
BIOPHYSICS
TEMPORARY INVESTIGATORS
CAPTAINS (8)
RATIONS (2)
EFFORT SYNDROME (1)
BACTERIOLOGY (1)
MEDICAL EQUIPMENT (2)
DAMAGE & CONVALESCENCE (1)
AMOEBIASIS SURVEY (1)

APPENDIX "B"


FUNCTIONAL CHART OF AMD 8
DGMS
DDGMS (A)
AMD's
1
2
3
4
DDGMS (B)
AMD's
5
6
7
8
NRC
ASSOCIATE COMMITTEE ON ARMY MEDICAL RESEARCH
CO-ORDINATION WITH OTHER MEDICAL RESEARCH GROUPS
ARMY POLICY AND LIAISON ON MEDICAL RESEARCH
LIAISON, SCIENTIFIC REPORTS AND FUNDS
LIAISON
CMHQ
(#1 RESEARCH UNIT)
(LONDON)
WASHINGTON
INDIA
AUSTRALIA
SOUTH AFRICA
CMID
LIBRARY
AMD 8
INFORMATION
FROM LIAISON SOURCES
DGMS
DMS
A 22 TC
OTHER SERVICES
FIELD TRIALS
STANDING COMMITTEE ON NUTRITION
SUB COMMITTEE ON PROTECTIVE EQUIPMENT
DOS (GS)
DSD(W)
D OPS RESEARCH
DMT
DS & C
D ARTY
PETAWAWA
A 19
A 22
A 33
A 10-11
CAMP BORDEN
DEVELOPMENT
NIGHT VISION
(AMD 7)
TUMP LINE
(A 22)
EQUIPMENT
(AMD 3)
MOTION SICKNESS
SURVEYS
AMOEBIASIS
(AMD 5)
ANOPHELINE
(DOR)
UPPER RESP. DIS
(AMD 5)
INDUSTRIAL HYGIENE
(AMD 5)
PLAGUE
(AMD 5)
ANAEMIA
(AMD 6)
FOOT PROBLEMS
(AMD 6)
PSYCHIATRIC PROBLEMS
(AMD 6)
NUTRITIONAL PROBLEMS
(AMD 5)
AUDITORY DAMAGE
CLINICAL
DAMAGE & CONVALESCENT STATE
EFFORT SYNDROME
NERVE & BRAIN INJURY
NUTRITION

APPENDIX "C"

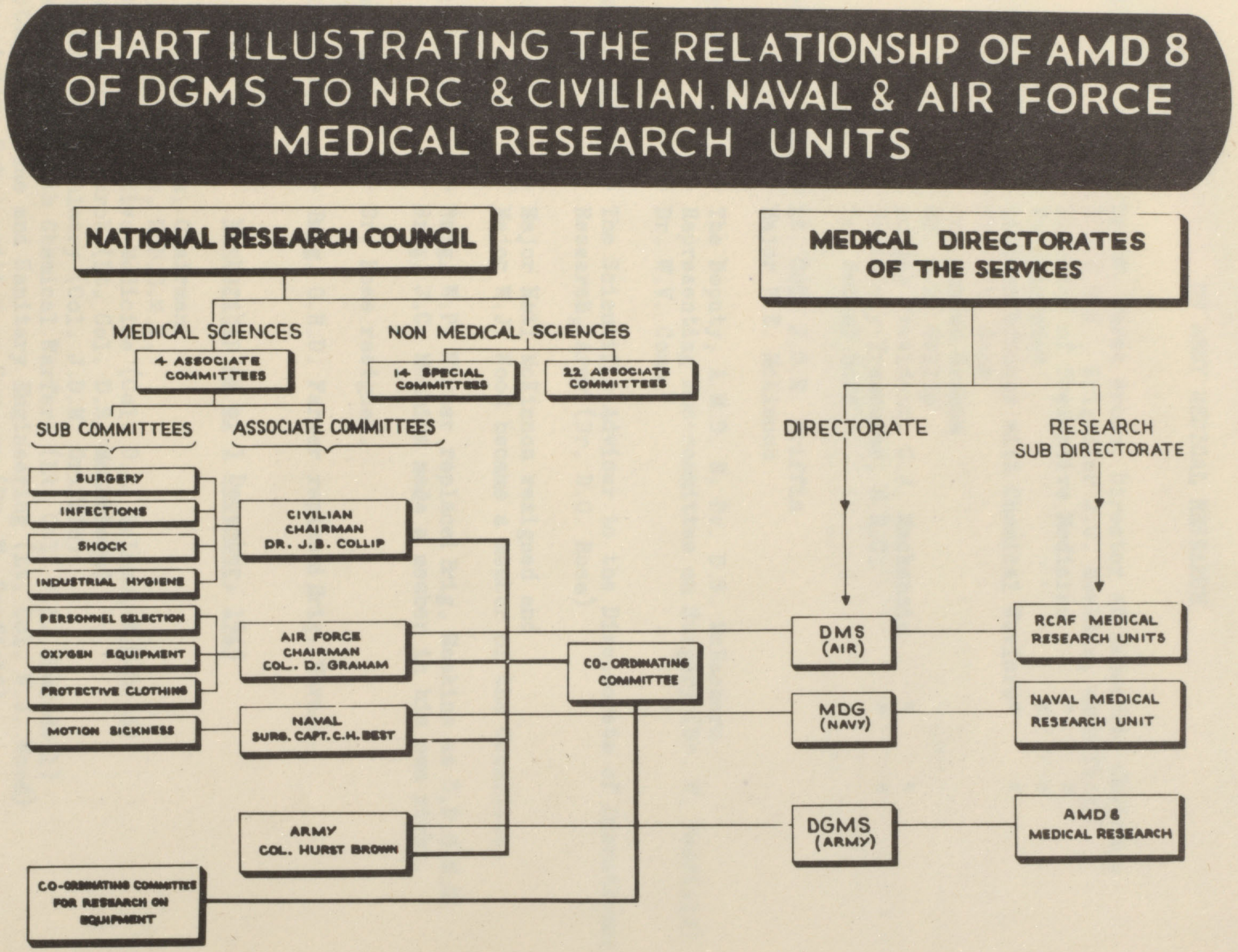


CHART ILLUSTRATING THE RELATIONSHP OF AMD 8 OF DGMS TO NRC & CIVILIAN. NAVAL & AIR FORCE MEDICAL RESEARCH UNITS

APPENDIX "D"

MAKE-UP OF COMMITTEE - ASSOCIATE COMMITTEE
ON ARMY MEDICAL RESEARCH

14 December, 1942 - Dr. W. Hurst Brown, Director of Research, Chairman
D.D.G.M.S., Brigadier J.C. Meakins, ex-officio
Director of Preventive Medicine " "
Psychiatrist " "
Liaison Officer with Chemical Warfare" "
Dr. W.H. Cook
Dr. Duncan Graham
Dr. J.B. Collip
Acting President, C.J. Mackenzie " "
Secretary-Treasurer, N.R.C. " "
Dr. Hebbel Hoff

7 September, 1943 - Lt. Col. J.D.M. Griffin
Major N.E. McKinnon

7 December, 1943 - The Deputy, A.M.D. 8, Dr. D.S. McEachern
- Representing Sub-committee on Surgery (Dr. W. Penfield)
- Dr. W.V. Cone.

January, 1944 - The Scientific Adviser to the Directorate of Operational Research, Army (Dr. D.C. Rose)

March, 1944 - Major Neil McKinnon resigned and
Major W.J. Wood became a member of the Committee.

July, 1944 - Brig. W.P. Warner replaced Brig. Meakins as D.D.G.M.S.
Brig. J.C. Meakins made a member in his own right.

10 May, 1945 - Dr. Rose resigned.

26 June, 1945 - Brig. G.R.D. Farmer replaced Brig. Warner.

Membership as of 1 December, 1945

Col. W. Hurst Brown, Chairman.
Brig. G.R.D. Farmer, D.D.G.M.S.
Director of Preventive Medicine (Col. D.L. McLean, A.M.D. 5)
Consultant in Research (Lt. Col. D.S. McEachern)
Consultant in Psychiatry (Col. J.D.M. Griffin)
Liaison Officer with Chemical Warfare (Lt. Col. J.L. Blaisdell)
Director of Hygiene and Sanitary Engineering (Lt. Col. W.J. Wood)
Representative Sub-committee on Surgery (Dr. W. Penfield)
Dr. J.B. Collip
Dr. W.V. Cone

Dr. W.H. Cook
Col. Duncan Graham
Dr. Hebbel Hoff
Dean J.C. Meakins
President, M.R.C.
Sec. Treasurer, N.R.C.
Mr. S.J. Cook, Executive Secretary
Capt. E.O. Hughes, Honorary Secretary
(no one named to succeed Dr. Rose as Scientific Adviser to the Directorate of Operational Research).

22 December, 1945 - Dr. D.S. McEachern a member in his own right.
- Lt. Col. R.M. Kark replaces Dr. D.S. McEachern as Consultant in Research.
- Directorate of Hygiene and Sanitary Engineering non-existent and is now encompassed by Directorate of Preventive Medicine.
- Capt. D.M. Bell replaces Capt. E.O. Hughes as Honorary Secretary.

APPENDIX "E"

LIST OF OFFICERS, OTHER RANKS AND CIVILIAN PERSONNEL ASSOCIATED WITH A.M.D. 8

- OR -

CONTRIBUTING TO REPORTS TO THE ASSOCIATE COMMITTEE ON ARMY MEDICAL RESEARCH

HEADQUARTERS AMD 8, OTTAWA

OFFICERS

W.H. Brown	Colonel
D.S. McEachern	Lt. Col.
J.L. Blaisdell	Lt. Col.
W.R. Feasby	Lt. Col.
R.M. Kark	Lt. Col.
A.J. Cipriani	Major
R.H. Ozburn	Major
D.R. Warren	Major
D.M. Bell	Capt.
E.O. Hughes	Capt.
J.H. Whittaker	Capt.
M.E. Rose	Lieut.

OTHER RANKS

J. Archibald	S/Sgt.
G.G. Dennis	Cpl.
F. Glenny	Cpl.
P.D. Hopwood	Pte.
J.J. Skula	Pte.

OTHER RANKS
(CWAC)

J. B. Jewett	Sgt.
M.V. Willson	Sgt.

CIVILIAN PERSONNEL

Mrs. Parker	N.R.C.
Miss E. Bowman	
Miss J. Chalmers	

WASHINGTON

OFFICERS

J.B. Collip	Colonel
A. Neufeld	Major

OTHER RANKS

D.L. Conran Smith	Sgt.
M.A. Vadheim	Cpl.

OTHER PERSONNEL

OFFICERS

W.P. Warner	Brigadier
J.D. Adamson	Colonel
J.D. Griffin	Colonel
R.I. Harris	Colonel
F.B. Lloyd	Colonel
C.V. Ward	Colonel
R.W. Boyd	Lt. Col.
A.L. Chute	Lt. Col.
J.F. McCreary	W/C RCAF
F. Hartley Smith	Lt. Col.

OFFICERS

John Squire	Lt. Col. R.A.M.C.
H. Aronovitch	Major
T. Beath	Major
H. Bensley	Major
D.C. Bews	Major
S. Bliss	Major, M.C., U.S.A.
M.H. Brown	Major
F.R. Chown	Major
J.N.B. Crawford	Major
R.A. Cleghorn	Major
Harvey Cruikshank	Major
F.S. Dawson	Major
Joseph Doupe	Major
George Ferguson	Major
John Hamilton	Major
A.S. Hartcroft	Major
N.A. Hitchman	Major
R.P. Howard	Major
T.H. Johnson	Major
G.A. Josie	Major
R.F. Keevil	Major
J. Kershman	S/L RCAF
G.H. Lathe	Major
B.D.B. Layton	Major
A.F.W. Peart	Major
J.A.F. Stevenson	Major

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OFFICERS

E.L. Lynch	Major
R. Melson	Major Q.M.C., U.S.A.
G.C. Maloney	Major
Viola Rae	Major
R.E. Ralph	Major
T. Renbourne	Major R.A.M.C.
P. Robb	S/L, RCAF
W.D. Ross	Major
T.E. Roy	Major
J.S. Smit	Major
G.G. Taylor	Major
I.C.C. Tchaperoff	Major
M.J. Tuttle	Major
A.M. Vineberg	Major
D.R. Warren	Major
C. Webster	Major
C.R. Wiseman	Major
L. Zacks	Major
E.B. Archibald	Hon. Capt.
S.M. Banfill	Capt.
Claud Bertrand	Capt.
D.W.S. Best	Capt.
V. Blockley	Capt.
C.R. Bourgeois	Capt.
F.R.C. Chalke	Capt.
M.A. Chepesuik	Capt.

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OFFICERS

F.E. Coburn	Capt.
W. Crowson	Capt.
E. Farber	Capt.
E.T. Felsted	Capt.
C.F.S. Fisher	Capt.
W.O. Forde	Capt.
R. Friedman	Capt.
B.R. Gibson	Capt.
J.A. Gilbey	Capt.
G.C. Gray	Capt.
L. Greenberg	Capt.
G. Harris	Capt.
J.A. Harrison	Capt. R.A.M.C.
T.A. Hemphill	Capt. R.A.M.C.
M.F. Henderson	Capt.
H.H. Jasper	Capt.
B.S. Kent	F/L, R.A.F.V.R.
J.S. Lewis	Capt.
I.M. Mackay	Capt.
John MacKenzie	Capt.
M.J. Miller	Capt.
D.R. Murphy	Capt.
N. Myant	Capt. R.A.M.C.
R.J. Patterson	Capt.
E.W. Peterson	Capt.

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OFFICERS

J.A.C. Reid	Capt.
M.L. Richardson	Capt. Q.M.C. U.S.A.
J. Romeyn	Capt.
D.W. Ruddick	Capt.
Kal. Seaman	F/L R.C.A.F.
S.J. Shane	Capt.
J.G. Sheps	Capt.
W.J.W. Smith	Capt.
H. Stansfield	Capt.
J. Stein	Capt. R.A.M.C.
P.H. Spohn	Capt.
Glen Turner	Capt.
J.A. Turner	Capt.
J.R. Wagner	Capt.
H.B. Wallis	Capt.
P.R. Weil	Capt.
H.F. Aiton	Lieut.
R.H. Johnston	Lieut.

OFFICERS (CWAC)

M. Stanford	Capt.
M.E. Brookfield	Lieut.
M.S. Foster	Lieut.
M.M.G. Macdonald	Lieut.
J.N. Mitchell	Lieut.
E.M. Patterson	Lieut.

OFFICERS
(CWAC)

S. Stevenson	Lieut.
H.T. Sullivan	Lieut.

OTHER RANKS

C. Webber	B.Q.M.S.
L.H. Blackburn	C.Q.M.S.
G.A. Dunsmore	C.Q.M.S.
E.J. Kendall	C.Q.M.S.
S.F. Maher	C.Q.M.S.
E.D. Pease	W.O. II
J.F. Steele	S/Sgt.
G.D. Allen	Sgt.
D.M. Beldam	Sgt.
E.C. Brydges	Sgt.
K.G. Cameron	Sgt.
J.L. Castles	Sgt.
L.A. Dumond	Sgt.
F.W. Glover	Sgt.
J.R. Holloway	Sgt.
D.G. Humm	Sgt.
J.F. Julian	Sgt.
H. McIntyre	Sgt.
G. Ruel	Sgt.
R. R. Watson	Sgt.
J.E. Wixon	Sgt.
C.A. Woolner	Sgt.

OTHER RANKS

E.D. Barnett	Cpl.
F.G. Clark	Cpl.
V. Clemmenson	Cpl.
J. Findlay	Cpl.
H.V. Holway	Cpl.
J.R. MacCallum	Cpl.
K.F. Provost	Cpl.
M. Rehkopf	Cpl.
J.P. Varette	Cpl.
G.F. Bank	Pte.
A.R. Boothroyd	Pte.
R.E. Conway	Pte.
G.A. Davidge	Pte.
C.A. George	Pte.
L. Groulx	Pte.
C.J. Harris	Pte.
Q.F. Harrison	Pte.
E. Kowalski	Pte.
J. Licastro	Pte.
V.M. Littlefield	Pte.
J.M. McAloney	Tpr.
R.S. McClennen	Pte.
H. McIntosh	Pte.
A.J.G. Mayo	Sgn.
D.R. Miller	Pte.
R.B. Prescott	Gnr.

APPENDIX "E"

CIVILIAN SCIENTISTS

Dr. Acker, M.I.

Dr. Altschul, R.

Dr. Andreae, W.A.

Mr. Battista, A.

Mr. Bayley, C.

Miss Beattie, Dorothy M.

Mr. Bornstein, M.B.

Mr. Bowen, Henry B.

Dr. Boyd, E.M.

Mr. Brown,

Dr. Browne, J.S.L.

Prof. Burr, E. Godfrey

Dr. Bynoe, E.T.

Miss Carruthers, Natalie

Miss Chalmers, Edith A.

Mr. Chapman, D.G.

Dr. Clark, J.

Dr. Cone, William V.

Mr. Consolazio, Frank,
Harvard Fatigue Laboratory

Dr. Cook, W.H.

Miss Copeland, Joan

Dr. Cotes, Harry

Dr. Crampton, E.W.

Dr. Elliott, K.A.C.

Dr. Frappier, Armand

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CIVILIAN SCIENTISTS

Mr. Geddes, L.A.

Mr. Gibbard, J.

Dr. Gurd, Fraser

Mr. Hall, A.G.

Dr. Hare, Ronald

Dr. Hill, R.H.

Prof. Hoff, H.E.

Dr. Hoffman, M.M.

Dr. Hunter, George

Dr. Hunter, M.E.F.

Mr. Illman, W.I.

Miss Jackson, Jocelyn

Dr. Johnson, L.P.V.

Dr. Johnson, R.E.,
Harvard Fatigue Laboratory

Dr. Kaufman, J.

Miss King, R.

Dr. Lawruk, A.

Dr. Ledingham, G.H.

Mr. Lusena, C.V.

Dr. Marois, Paul

Dr. Marion, T.

Miss McCready, M.S.

Dr. McFarlane, W.D.

Miss McGarry, Eleanor

Dr. McPhail, M.K.

CIVILIAN SCIENTISTS

Mr. Meyer, John

Miss Mills, Margaret F.

Miss Moffat, Miriam D.

Miss Morgan, Jean

Dr. Mortimer, H.

Mr. Naubert, J.

Miss Newman, L.

Dr. Noble, R.L.

Mr. Notman, Ralph

Miss Onesti, Sylvia

Mr. Rice,

Dr. Rice, H.V.

Dr. Ripley, Howard R.

Mr. Robinson, Paul
Harvard Fatigue Laboratory

Mr. Rose, G.R.T.

Dr. Schenker, Victor

Mr. Scott-Paine, H.

Mr. Poulin, Joseph
Harvard Fatigue Laboratory

Miss Stamatis, Dorothy M.

Miss Sutherland, H.A.

Dr. Taylor, F.H.L.
Thorndike Memorial Laboratory

Dr. Venning, E.H.

Mr. Walker, A.R.

APPENDIX "E"

CIVILIAN SCIENTISTS

Dr. Waugh, T.R.

Dr. Weld, C.B.

Mr. Weatherburn, A.S.

Mr. Young, G.A.

APPENDIX "F"

ARMY MEDICAL PROJECTS

Army Med. Proj. No.	TITLE
1	Investigation of Night Vision.
2	Investigation of Effort Syndrome.
3	Development of Suitable Methods of Preparing Sprouted Cereals and Legumes to Supply Balanced Nutritional Supplements in Bulk to Troops Stationed in Isolated Areas and to Civilian Populations for use in time of Famine.
4	Evacuation of Wounded from the Battlefield.
5	Survey of Streptococcus Research at Camp Borden.
6	Investigation of Atypical Respiratory Tract Infections.
7	Nutritional Surveys of Groups of Canadian Soldiers.
8	Investigation of Medical Aspects of Air Ambulance Transportation.
9	Studies on Barbiturates in Relation to Motion Sickness and Gastric Physiology.
10	Research in Fumigants, Insect Repellents and other Insecticides. Plague Survey.
11	Development of an Individual Water Purifier.
12	Hydroponics at Goose Bay, Labrador.
13	Research on Protective Clothing.
14	Some Metabolic Aspects of Damage and Convalescence.
15	Nutritional Anaemia in Women (C.W.A.C.)
16	Army Industrial Hygiene and Occupational Disease Control.
17	A Studyof the Persistance of the Bacteriostatic and Bactericidal Activity in Fabrics Treated by Various Chemicals.
18	Coagulation Test: To Demonstrate Tendency towards Increased Coagulability of Blood with Reference to Thromboplastic Content, which has not been Demonstrated by Existing Tests.
19	Nutritional Studies in the Field.

APPENDIX "F" (Contd).

Army Med. Proj. No.	TITLE
20	Study 'in Vivo' of the Antiseptic Value of the Substance called "Perm-Aseptic" and other Similar Substances.
21	Investigation into the Prevalence of Carriers of Entamoeba Histolytica in the Canadian Army.
22	Soldier's Foot Survey.
23	The Development of Suitable Audiometric Equipment for the Investigation of Aural Trauma and Allied Conditions in the Armed Forces.
24a	Survey of Civilian Readjustment of Soldiers Discharged because of Psychoneurosis.
24b	Investigation of Personal Adjustment of C.W.A.C. Personnel.
25	A Study of the Metabolism of Hydrogenated Fats with Special Reference to Toxic Effects.
26	The Toxicity of Deleterious Action of Biscuits in Canadian Mess Tin Ration and American 10 in 1 Ration Compared with a Standard Diet in Animals.
27	Survey of Canadian Anophelines and Insecticidal Investigations.
28	Traumatic Injuries of the Nervous System.
29	Investigation of the Effects of X-ray Treatment of Infection with Special Reference to the Part Played by Essential Metabolites in Bacterial Growth.
30	Tropicalization of Medical Stores.
31	Psychiatric Research in Therapeutic Occupation.
32	Hormonal Influence of Nerve Regeneration.
33	A Plastic Substitute in the Making of a Plaster of Paris Cast.
34	Postural Adjustment of the Circulation and the Relation to Postural Syncope.
35	Production of a Wide Variety of Palatable High-Protein Supplementary Feedings for Patients.
36	The Development of Evaporated or Dehydrated High-Protein, High Caloric Nutritional Supplements.

APPENDIX "F" (Contd.)

Army Med. Proj. No.	TITLE
37	Further Study of the Usefulness of Different Types of Shortenings when Incorporated in Biscuits at Various Levels and with Different Baking temperatures.
38	Diagnostic Methods for Psychosomatic Conditions.
39	Development and Experiments on Mud Shoes.
40	Heparin and Blood Fat.
41	Nutritional Assessment of Hospital Diets.
42	The Emotional Reaction in Selected Groups to Traumatic Battle Scenes, Measured by Rorschach Responses.
43	Recoding of Army Medical Documents.
44	Intra-Arterial Pentothal Injections.
45	Overseas Research Team.
46	Rh Sensitivity Resulting from Blood Transfusions.
47	Inhibition of Growth of Tubercle Bacilli.
48	Effect of Protein, Non-Protein Caloric Ratio and Type of Feeding Practised on Growth of Rats.
49	Nutritional Disease (avitaminosis) Among Canadian P.O.W. in Hong Kong and Japan.
50	Nutritional Studies on Exercise Musk-Ox.
51	Study of Air Borne Infection.
52	To Determine if there is any direct chemical reaction between P-aminobenzoic acid and various bacteriostatics.
53	Electromyographic Studies of Neuromuscular Disease.
54	Blocks in some of the Peripheral Vasospastic Diseases.
55	Preparation of a History of the Associate Committee on Army Medical Research.
56	Study of Determination of Blood Acetone at the Bedside.

APPENDIX "G"

NIGHT VISION

Reports resulting from work in Canada

C.6028 Night Vision Training and Testing Unit.
D. McEachern.
B.D.B. Layton.
E. Godfrey Burr.

C.6030 Night Vision Tests at Camp Shilo.
M.M.G. Macdonald.

C.6034 Lighting of Coast Artillery Batteries.
A.J. Cipriani.

C.6040 Night Vision Training and Testing Manuals.
M.M.G. Macdonald.

C.6044 The Effect of Night Vision Training on Performance of Night Vision Tests.
B.D.B. Layton.
C.R. Bourgeois.
D.S. McEachern.

C.6075 Interior Lighting of the Canadian Scout Car.
A.J. Cipriani.

C.6078 Photoelectric Calibrator for use with the Burr Night Vision Tester.
A.J. Cipriani.

Reports from Overseas

C.6087 Night Vision Testing, Canadian Army Overseas.
M.J.T. Tuttle.
W.J.W. Smith.

C.6110 Estimation and Control of Light Levels use for Night Vision Testing.
M.J. Tuttle.

C.6190 A Study of the Relation of Night Vision Ability to Age in Canadian Army Personnel.
M.J. Tuttle.

C.6223 Report on Night Vision.
D.A. Mackay.
W.J.W. Smith.

EVACUATION OF WOUNDED BY LAND

C.6038	Use of Tump Line Principle in Evacuation of Wounded. J.S. Smit.
C.6066	The Training of Stretcher Bearers in the Use of the Tump Line Principle and the Development of New Equipment for Tump Line Carriage of Casualties and Material. E.B. Archibald.
C.6085	Report on Demonstration of Tump Line Method for Carrying Casualties. D.S. McEachern.
C.6199	Trials of Packboards and Tump Line Equipment. Commandant A.22 CAMC, TC.

BACTERIOSTATIC FABRICS

C.6018	The Testing of Blankets and Cotton Shirting Treated with a Bactericidal Preparation. J. Gibbard. J. Naubert.
C.6052	Bacteriostatic Treatment of Fabrics. J. Gibbard. J. Naubert.
C.6053	Lousicidal Tests with Perm-Aseptic Treated Blankets. F.R. Chown.
C.6054A	Organization of a Large Scale Set-up for Testing Effect of Control Agents on Respiratory Disease. F.P. Lloyd.
C.6054B	Progress Report of Field Trials on the Effects of Perm-Aseptic Treatment of Blankets upon the Incidence of Respiratory Disease. F.P. Lloyd. A.J. Cipriani. E.C. Hughes.
C.6054C	A Summary of Agents Reputed to Render Fabrics Bacteriostatic and Fungicidal. D.S. McEachern. Joan Whittaker.
C.6054D	Air Sampling and Activity of Perm-Aseptic in Blankets. R. Friedman.
C.6074	In Vivo Studies of the Antiseptic Value of Perm-Aseptic and other Bactericidal Compounds. A. Frappier. Paul Marois

C.6084	Bacteriostatic Treatment of Fabrics. C.H. Bayley.
C.6115	Field Trial of Perm-Aseptic Treated Blankets. F.P. Lloyd.
C.6128	Bacteriostatic Action of Treated Fabrics. R. Friedman.
C.6129	Skin Sensitivity Tests with Some Bacteriostatic Substances. D.W.S. Best.
C.6133	In Vivo Studies of the Antiseptic Value of the Substance Called "Perm-Aseptic" and similar Substances. A. Frappier. P. Marois.
C.6136	Application of Oil to Hospital Blankets (I) Laboratory Experiments with Wool. C.H. Bayley. A.S. Weatherburn.
C.6184	Study in Vivo of the Antiseptic Value of the Substance called "Perm-Aseptic" and other Similar Substances. A. Frappier. P. Marois.
C.6188	The Application of Oil to Hospital Blankets, (II) Pilot Plant Trials with Wool. C.H. Bayley. A.S. Weatherburn.
C.6189	The Application of Oil to Hospital Blankets, (III) Use of Highly Concentrated Stock Emulsions. A.S. Weatherburn. C.H. Bayley.
C.6226	Skin Sensitivity Tests on Clothing Impregnated with Some Bacteriostatic Substances. D.W.S. Best.
C.6251	Application of Oil to Hospital Blankets, (VI) Control of the Fatty Acid Content of Oiled Blankets. J.R.F. Rose. C.H. Bayley A.S. Weatherburn.
C.6252	The Application of Oil to Hospital Blankets, (IV) Commercial Trial at Sanitary Laundry, Ottawa. A.S. Weatherburn. C.H. Bayley.

C.6253 The Application of Oil to Hospital Blankets, (V) Physiological Examination.
C.H. Bayley.
A.S. Weatherburn.

C.6254 The Application of Dust-laying Oil to Cotton.
C.H. Bayley.
A.S. Weatherburn.

AMOEBIASIS SURVEY

C.6077 Incidence of Amoebiasis in Army Personnel Returning from the Mediterranean Area.
D.C. Bews.

C.6116 Amoebiasis Survey in the Canadian Army.
M.J. Miller.

NUTRITIONAL AND ENVIRONMENTAL RESEARCH

Nutrition. Compact Rations

Field Test Trials of Rations - Camp Penosquis, N.B.
W. Hurst Brown.
J.F. McCreary.
(Edward Cloutier - Ottawa, (1943)

Ration Trials - Prince Albert, Sask.
R.M. Kark.
J.F. McCreary.
(Edward Cloutier - Ottawa, (1944)

C.6014 Nutrition. Field Trials of Dehydrated Meat Bars. (NRC) as a Proposed Emergency Ration.
R.M. Kark.
J.S. Smit.
E. Farber.

C.6132 Methods of Evaluation of Compact Rations.
R.M. Kark.
J.F. McCreary.
R.E. Johnson.

Nutrition. Ketonemia.

C.6118 The Nutritive Value of the Ration as Influenced by Heating. Presence of Antioxidant and the Amount, and Melting Point of the Fat.
E.M. Boyd.
J. Copeland.
N. Carruthers.

C.6219 Further Study of the Usefulness of Different Types of Shortening when incorporated in Biscuits at Various Levels and with Different Baking Temperatures.
E.W. Crampton.
M.F. Mills.

C.6120 The Effects of Diets of Type "C" and Various "K2" Biscuits and of Baked Whole and Skim Milk upon Albino Rats.
E.M. Boyd.
J. Copeland.
N. Carruthers.

Metabolism in Damage and Convalescence

C.606A Some Metabolic Aspects of Damage and Convalescence.
J.S.L. Browne.
V. Schenker.
J.A.F. Stevenson.
M.E.F. Hunter.

C.6060B Comparison of Actual and Presumed Food Intake of Patients in a Military Hospital.
H.A. Sutherland.
J.A.F. Stevenson.

C.6131 Inadequate Protein and Caloric Intake of Patients in Military Hospitals: A Study of Contributory Factors.
J.A.F. Stevenson.
H.A. Sutherland.
G.G. Taylor.
R.M. Kark.

C.6135 Vitamin Requirements in Damage.
W.A. Andreae.
M.E.F. Hunter.

C.6137 Nutrition in Damage and Convalescence.
Conference.

C.6140 Further Observations on the Metabolic Aspects of Damage and Convalescence.
J.S.L. Browne.
V. Schenker.
P.G. Weil.

C.6171 Brief Summary of Findings Made Under Army Med. No. 14.
J.S.L. Browne.

C.6176 Studies on Nitrogen Metabolism.
V. Schenker.
P.G. Weil.
E.H. Venning.
J.S.L. Browne.

C.6177 Studies on Vitamin Requirements in Damage and Convalescence.
W.A. Andreae.
P.G. Weil.
J.S.L. Browne.

C.6178 Nutrition and Liver Function: The Effects of Malnutrition, Operation, Shock and Burns on liver Function, and the Effects of Special Nutritional Measures in Improving Liver Function.
M.M. Hoffman.
P.G. Weil.

C.6179 Supplementary Feeding Mixtures for Convalescent Army Personnel: Preliminary Clinical Test.
H.A. Sutherland.

C.6193 Survey of Hospital Diets at Two Canadian Military Hospitals.
J.H. Whittaker.
L. Newman.

C.6197 Flavouring Tests for a Special High Protein Milk Shake.
M.S. McCready.

C.6225 Vitamin Metabolism in Damage and Convalescence.
W.A. Andreae.
J.S.L. Browne.

C.6235 Investigation of Hospital Diets.
G. Hunter.

C.6236 Development of High Protein Milk Supplement.
G.G. Taylor.

C.6248 Pre-operative Nutrition in Patients with Peptic Ulcers: Preliminary Observations of Cases in Royal Victoria Hospital Receiving Protein Hydrolysates (Amigen).
J. Clark.
V. Schenker.

C.6249 General Consideration Regarding Protein Metabolism after Damage in Convalescence.
J.S.L. Browne.

Nutrition in Convalescence.
J.A.F. Stevenson.
V. Schenker.
J.S.L. Browne.
Journal Cdn. Med. Services 2: 345 (1945)

Canadian Research Team, South East Asia Command

C.6117 The Construction and Development of Biochemical Kits for Field Use.
H.F. Aiton.
E.D. Pease.

C.6191 Jungle Field Trial of Indian Compo 8-man Ration (I.R.)
R.M. Kark.
H.F. Aiton.
E.D. Pease.

C.6192 The Physical Fitness, General Health and Nutritional Status of 140 Gurkha Reinforcements.
R.M. Kark.
H.F. Aiton.
E.D. Pease.

C.6201 The Feeding of Tank Crews, 14th Army.
R.M. Kark.
H.F. Aiton.
E.D. Pease.

C.6203 The Nutritional Status of 29 Japanese P.O.W. 14th Army.
R.M. Kark.
H.F. Aiton.
E.D. Pease.

C.6204 The Nutritional Status of Indian Troops, 14th Army. Part 1V, General Review.
R.M. Kark.
H.F. Aiton.
E.D. Pease.

C.6206 The Nutritional Status of Indian Troops, 14th Army. Part I, Pioneer Corps and Army Service Corps.
R.M. Kark.
H.F. Aition.
E.D. Pease.

C.6208 The Nutritional Status of Indian Troops, 14th Army Part II. The Relationship between Environmental Nutrition and Operational Fitness.
R.M. Kark.
H.F. Aiton.
E.D. Pease.

Studies on Nutrition, Environment and Physical Fitness

C.6015 A Nutritional Survey and Environmental Study of Newly Enlisted Draftees.
R.M. Kark.
M.E.F. Hunter.
J.S. Smit.
T. Marion.

C.6036 The Food and Feeding Habits of Newly Enlisted Draftees.
T. Marion.
R.M. Kark.
M.E.F. Hunter
J.S. Smit.

C.6041 Sub-Clinical Scurvey.
M.E.F. Hunter.
R.M. Kark.
J.S. Smit.

C.6069 A Nutritional Survey and Environmental Study of Newly Enlisted Draftees: A Preliminary Report of the Biochemical Aspects of the Study.
R.M. Kark.
M.E.F. Hunter.
J.S Smit.
T. Marion.

Hydroponic Vegetable Growth

C.6033 The Application of Hydroponic Vegetable Growth Methods to Nutritional Problems in Northern Climates.
R.M. Kark.
R.H. Hill.
J.A. Gilbey.

C.6064 Soil Conditions in Northern Newfoundland and Labrador.
H.Hill.

Sprouted Seeds as Nutritional Supplements

C.6008 The Development of Suitable Methods of Preparing Sprouted Cereals and Legumes to Supply Balanced Nutritional Supplements in Bulk, to Troops Stationed in Isolated Areas and to Civilian Populations for use in time of Famine.
W.A. Andreae.
E.A. Chalmers.

C.6043 The Production of Vitamin "C" by Sprouting Seeds.
L.P. Johnson.
G.A. Young.

C.6046A The Ascorbic Acid, Riboflavin and Thiamin Content of Cereal Sprouts and their Possible Dietary uses.
W.A. Andrea.

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