In a later paper I shall discuss the gross and microscopic pathology of the rat eye and its adnexa, and the resemblance of its phenomena to those found in pathologic conditions of the human eye; also the different views of the etiology of these ocular manifestations.

CONCLUSION

It is my impression that, from a clinical standpoint, the incipient changes in the eyes of rats showing nutritive disturbances on diets deficient in vitamin A are like the condition known as xerosis of the conjunctiva and cornea in man; and the more advanced picture is that of keratomalacia.

THE VALUE OF REST IN CASES OF EMPYEMA AND LUNG ABSCESS

J. S. PRITCHARD, M.D.

BATTLE CREEK, MICH.

In acute pulmonary tuberculosis and in certain derangements of the nervous system, it is generally admitted that the rest regimen is a success. This treatment requires complete relaxation, both mental and physical, and any influence which causes increase in the cardiac effort constitutes exercise and is the antithesis of rest. In order to secure the maximum amount of rest, something more than being confined to bed is required. Apprehension, worry and mental depression act as physical stimulants, while emotions caused by noise, anger and arguments upset the vasomotor equilibrium and defeat efforts employed to obtain this form of treatment. The patient should therefore be freed from all responsibility, quietness assured, and a pleasant, cheerful and optimistic environment established.

When dealing with a severe infection, such as the acute stage of empyema, rest is imperative. Following the active phase, the inflammatory process in the pleura becomes localized, a pyogenic membrane forms, and a different condition presents itself for treatment. In this state a mechanical problem may exist, owing to a displacement of the mediastinum or limitation of lung capacity with associated dyspnea and circulatory disturbances. By this time the patient has become exhausted, and little difficulty is experienced in convincing him of the importance of rest. It should be definitely established that the pleural sac contains pus; this is usually determined by the introduction of a needle, the variations of the leukocyte count, the history and the physical examination, including roentgen-ray findings. If an empyema exists, thoracotomy should be performed. Prior to this, rest has been the natural result of exhaustion. Following surgical interference, its use as a therapeutic measure is unfortunately rapidly discarded, because the patient is improving, the offending substance in the chest has been removed, and a slow but definite return to a feeling of well-being is experienced. It is now that the continuation of absolute rest is of such great importance and often so difficult to secure.

Guarded and graduated exercise may be added to the treatment. Sitting up in a chair and taking a few steps each day constitute the best means of slowly winning the patient back to a state of confidence. The change should be gradual, for too vigorous mental or physical exercise frequently results in an exacerbation of the affection.

METHOD OF TREATMENT IN EMPYEMA

During the last three years, twelve cases of empyema have been treated at our clinic in the following manner:

Before thoracotomy was performed, there was reason to believe that the acute inflammatory process in the pleural cavity had subsided and that the empyema was well walled off. Drainage was established at the lowest point (posterior axillary region). In each case, before thoracotomy, an attempt was made to ascertain the position of the diaphragm by fluoroscopic and roentgenographic study. Adequate drainage being of greatest importance, the surgical communication between the pleural cavity and the exterior was made in such a manner as to insure an orifice equal in width to that of the lower empyemic area. A large, short rubber tube was then inserted, and some form of one way valve was attached to the exposed end of the tube.

For the first ten days after rib resection, the typhoid rest regimen was instituted. This was followed by a ten day period in which the patients were allowed to sit up for a while each day and the use of the commode was permitted. No further privileges were granted, and in the majority of cases this treatment was continued until the discharge had disappeared for at least two weeks.

A daily charting of the temperature and a frequent leukocyte count during the period of convalescence revealed, in some instances, evidence of drainage interference. Single roentgen-ray films usually revealed a displacement of the drainage tube, the correction of which brought about a subsidence or disappearance of untoward symptoms.

Fresh air proved to be an excellent adjunct to the rest treatment, and when possible the patients were placed on porches, some of them spending the entire twenty-four hours outdoors. This improved the appetite and exerted a markedly beneficial effect on the nervous and mental state. The patients were encouraged to eat a liberal amount of nutritious food; those underweight were given special attention with reference to diet, and the bowels were regulated by a liberal supply of liquid petrolatum, fresh vegetables and the consistent drinking of a reasonable amount of water.

An average case required from four to eight weeks in bed under this regimen; the severe cases required a longer time.

When chronic empyemic cavities persisted after a reasonable period of rest, thoracoplastic surgery was employed. The patients stood surgical interference well, the long standing absorption having apparently established a definite immunity to the infecting organisms.

Of the twelve cases treated in this manner, seven were acute and resulted in satisfactory recoveries. The average stay in bed following thoracotomy was thirty-two days. Of the remaining five chronic cases, resection was performed in the first about three months before the patient came under our observation, but after sixty-four days of bed rest all symptoms disappeared. The second patient came for treatment a year after resection; after the establishing of a more complete drainage, about 1,600 c.c. of pus was released. This patient gained 40 pounds (18 kg.) in weight during three months of rest treatment, but the immense empyemic cavity did not recede, and a four stage thoracoplastic operation, necessitating the removal of parts of the lower eleven ribs, was followed by a complete recovery. The third patient, a boy, aged 9, suc-

cumbed to a meningitis following the thoracotomy for the relief of an empyema of three months' standing. The fourth patient made an excellent improvement, but refused surgical treatment for the relief of a persistent small sinus. The fifth case is reported in detail:

History.—A man, aged 27, came under my observation in May, 1920, twelve weeks after an attack of pneumonia followed by empyema. The previous history was unimportant. The present weight was 126 pounds (57 kg.); the average, 145 pounds (66 kg.); the maximum, 182 pounds (82.5 kg.). The pulse was 96; temperature, 99.8 F. The patient complained of weakness, depression, loose, productive cough, copious yellow expectoration frequently tinged with blood, irregular night sweats, loss of appetite, and a heavy feeling in the right side.

Examination.—The patient looked ill; his nutrition was poor, his development, fair. The shape of the chest was normal. The right thorax was deficient in expansion; a discharging sinus was present at the site of the previous thoracotomy—the seventh rib in the posterior axillary line. Feeble breath sounds and decreased resonance were elicited below the sixth rib in the back of the right thorax. Stereoroentgenograms of the chest revealed the thoracic circulatory system normal in size, shape and position. In the right lung a cloudy density occupied the root zone, and extended outward and downward to the periphery in the midaxillary region. The lung was compressed from the fourth to the eighth rib, in the anterior axillary line, and a distinct pleural space about 6 cm. in width was revealed between the lung margin and the ribs. Part of the seventh rib, posterior axillary, had been removed (original thoracotomy). The left was apparently normal.

Laboratory Examinations.—The blood Wassermann reaction was negative. Complement fixation for tubercle bacilli was negative. The white blood count was 11,000. The urine was normal. Twenty-two sputum examinations revealed no acid-fast bacilli or elastic tissue. Guinea-pig inoculation was negative.

Treatment.—Thoracotomy was performed in the posterior axillary line (ninth rib), a wide opening made in the midaxillary line (lowest point of the cavity), a drainage tube was inserted, and a small amount of Beck's paste was injected. This was coughed up in the expectoration the next day, proving the existence of a bronchial fistula. The patient was placed on bed rest for three months, during which time the discharge disappeared. The wound was allowed to close. The patient gained 34 pounds (15 kg.) and lost all symptoms except a slight cough with scanty expectoration. He was then allowed some light exercise, and a month later had a moderate hemoptysis. The rest treatment was reestablished, and at the end of two months all symptoms had disappeared.

Subsequent History.—At present, October, 1922, the patient is working. He weighs 160 pounds (72.5 kg.), feels well, and has been free from symptoms for more than a year. The empyemic cavity has healed; the bronchial fistula is apparently obliterated.

PULMONARY ABSCESS

In cases of pulmonary abscess it was found necessary to continue the bed rest for a much longer period of time than that required of the patients suffering from empyema. In most instances, the same strenuous regimen of rest was instituted as that employed in cases of active pulmonary tuberculosis. Little is thought of keeping the latter patients in bed for six months or a year. Why not enforce the same methods in the instance of a pulmonary condition that exhibits less tendency toward fibrosis?

In a period corresponding to that in which the empyemic cases were observed, twenty-one patients were found to be suffering from pulmonary abscess. Ten of these cases were acute or subacute, seven of which followed a tonsillectomy under general anesthesia, the patients coming to the clinic within a period

of from four to nine weeks following the first lower respiratory symptoms. Two cases followed pneumonia, and in the tenth case a causative factor was not determined.

Of the remaining eleven chronic cases, three followed tonsillectomy under a general anesthetic, four were a sequence of pneumonia, two occurred in diabetic patients and were finally proved to be tuberculous, one case followed an extensive abdominal operation, and the last one was associated with an advanced arthritis deformans.

Of the ten patients with acute abscess, five were placed on the rest regimen and four made complete recoveries in an average of from two and a half to four months of bed rest; the fifth showed excellent improvement after two months of rest, and then left the institution.

In the eleven chronic cases, it was apparent that good results would require a longer period of rest. Three of the eleven patients recovered after being placed on this treatment for from four to seven months. In the first case the abscess had existed for two years; in the second, eighteen months had elapsed since the beginning of symptoms, while the third patient had suffered for six months prior to treatment. Of the remaining eight patients, one made a reasonable recovery except that at intervals of a few months she expectorates a slight amount of blood-streaked sputum; a second patient died following a surgical attempt at drainage; the third case terminated by a cerebral embolism; the fourth case, associated with advanced arthritis deformans, naturally gave a hopeless prognosis. The two tuberculous cases were complicated by a long standing diabetes, and the one of unknown origin showed no improvement. The following description illustrates the first case of chronic abscess mentioned in this paragraph:

History.—Mrs. C., aged 29, complained of cough of two years' duration following influenzal pneumonia in January, 1919; this was accompanied by a feeling of fatigue and anorexia. Pneumonia at the right base two years before admission was followed in three weeks by a relapse of fever, and the sudden appearance of a copious amount of offensive yellow sputum. The fever, ranging from 99.8 to 101 F., continued for about nine weeks, during which period the patient lost weight and strength. The subsidence and disappearance of the acute symptoms was in turn followed by the present chronic symptoms of cough and yellow expectoration.

Examination.—The patient weighed 110 pounds (50 kg.) gross, average 130 pounds (60 kg.), the maximum being 145 pounds (66 kg.). There was moderate dyspnea; no cyanosis; the patient was pale and weak; cough was loose, persistent, frequent, and always productive of a characteristic yellow sputum. The fingers were definitely clubbed. Nutrition had remained good, in view of the two years of indisposition. The shape of the chest was normal; there was limited movement of the right base; there were decreased resonance and medium sized râles over the back of the right lung below the fifth rib, with some prolonged expiration below the sixth and eighth ribs, in the posterior axillary line. Grouped râles were heard between the third and sixth ribs, in the mid-clavicular line over the right side. The patient was able to drain sputum into the main bronchi by lying on the left side. Fluoroscopy disclosed an irregular, dense shadow in the lower right lung suggestive of that seen in cases of lung abscess. Movement of the right diaphragm was definitely restricted. Stereoroentgenograms of the right lung revealed the diaphragm flattened and elevated. Within the lung substance opposite the area between the second and fifth ribs in front there was a round, dense shadow with a clearer center, rather characteristic of a pulmonary abscess. The blood Wassermann reaction was negative. Frequent sputum exami-

nations revealed no acid-fast bacilli or elastic tissue. Each specimen contained much pus.

Treatment.—The patient was placed on the rest regimen for a period of more than five months, followed by six months of graduated exercise. During this time her cough and expectoration gradually decreased; at the end of a year she was walking from 3 to 4 miles a day, was attending to her domestic duties, had gained 39 pounds (18 kg.), and was entirely free from symptoms. Nine months have elapsed since then, and the patient has remained well. Some weakened breath sounds are still in evidence over the right base, and the percussion note is not clear, owing to a thickened pleura; but the stereoroentgenograms reveal little or no signs of the frank pathologic condition of twenty months ago.

COMMENT

It is worthy of note that in the foregoing series of twenty-one cases of lung abscess, ten followed a tonsillectomy in which a general anesthetic was used. The value of other methods of treatment is highly appreciated, such as surgery, pneumothorax, irrigation, heliotherapy, postural drainage and the administration of vaccines. It is believed, however, that with the addition of a longer period of bed rest to any or all of these forms of treatment, more gratifying results would be obtained in cases of pulmonary abscess.

A SEASONAL TIDE OF BLOOD PHOSPHATE IN INFANTS

ALFRED F. HESS, M.D.

AND

MARION A. LUNDAGEN, A.B.

NEW YORK

An investigation¹ undertaken somewhat more than a year ago showed that in infants the inorganic phosphate of the blood could be raised to the normal level by means of frequent exposures to the sun's rays. It was shown later² that the same result can be accom-

Chart 1.—Seasonal tide of blood phosphate (inorganic).

plished by irradiation with the carbon arc lamp. It seemed probable that this striking phenomenon—chemical equilibrium brought about by the action of light—is due to the ultraviolet, rather than to the visible rays of the spectrum. As a matter of fact, subsequent investigation has confirmed the view that some ultra-

violet radiations possess this biologic action, for when they are filtered out from the spectrum the rays lose this power.³ As is well known, the composition of the rays of the sun is not at all times the same. There is a marked seasonal variation in its spectrum—in the temperate zone the rays are incomparably richer in ultraviolet during the spring and summer than they are during the winter months.⁴ In view of this seasonal variation of the ultraviolet rays, and in view of the

Chart 2.—Seasonal tide of blood phosphate; diets, raw milk and dried milk.

pronounced effect of ultraviolet radiation on the inorganic phosphate of the blood, it seemed worth while investigating whether the transition of the seasons led to periodic chemical alterations. The infants who were tested were from 6 to 18 months of age, living under excellent hygienic conditions, and were on a diet of certified raw milk or of dried milk, as well as the usual amount of orange juice, the older ones receiving cereal in addition.

Chart 1 illustrates the result of this study. It will be noted that in the summer of 1921 the phosphate content of the blood was 4.34 mg. per cent., which is within the normal for the Bell and Doisy method. Further data were not available in 1921 until December, when it was found that the average had fallen to 3.92 mg. per cent. Monthly examinations, some 300 in all, comprising about sixty infants, demonstrated a steady decrease of the inorganic phosphate, the lowest ebb being in March. This level would have been still lower had it not been for the fact that whenever the phosphate content was found to be low (3.75 mg.) the child was given either sun treatment or irradiation from an artificial source. In fact, it was found that the blood test furnished a valuable criterion as to when heliotherapy should be instituted. In April the tide began to rise, ascending markedly in May, and rising to almost a normal level during June.

It is probable that this seasonal tide, with its summer flood and winter ebb, occurs to a greater or less degree in most bottle-fed infants living in the large cities.

3. Hess, A. F.; Pappenheimer, A. M., and Weinstock, M.: A Study of Light Waves in Relation to Their Protective Action in Rickets, *Proc. Soc. Exper. Biol. & Med.* **20**: 16, 1922.

4. This distinction is not due to a difference in quality of the rays themselves, but is an absorption effect resulting from the inclination of the sun and the average absorption coefficient of the atmosphere due to varying weather conditions. The ultraviolet portion of the sun's spectrum is much more sensitive to such changes than the red, and the altitude of the sun occasions a much greater relative difference in the degree of absorption.

1. Hess, A. F., and Gutman, P.: The Cure of Infantile Rickets by Sunlight as Demonstrated by a Chemical Alteration of the Blood, *Proc. Soc. Exper. Biol. & Med.* **19**: 31, 1921.

2. Hess, A. F., and Unger, L. J.: Use of the Carbon Arc Light in the Prevention and Cure of Rickets, *J. A. M. A.* **78**: 1596 (May 27) 1922.