weeks later these tubes both wore out, and we had considerable difficulty in obtaining substitutes which gave as satisfactory results, for several of the tubes employed, instead of producing the defluvium in fifteen minutes, required about double that time to do so, as indicated by the pastille, or necessitated more than one exposure. If the treatment of ringworm by the x rays is to be a practical success and a real saving of time, it is necessary that a single exposure should produce a clean defluvium of the area exposed without impairing regrowth. As the effects of the x rays are cumulative, to have to give repeated exposures seems to me to subject the patient to greater risk, and certainly with the long exposure of about fifteen minutes it is unsafe to re-expose the same area for at least twenty-one days.

In view of these facts, I have been trying for the last three months to find out what degree of tension was required in the tube to give the desired effect and at the same time to improve the technique with regard to the measurement of dosage and other details. With this object the following apparatus has been constructed, and by means of it the chief difficulties have been overcome.

The electrical current is obtained from a lighting main continuous current. A "dipper" mercury break is employed and a 12-in. spark coil. Connected with the break is an instrument known as a "speed counter," which records on a dial the number of plunges of the dipper into the mercury of the break. The dial is divided into fifteen divisions, each of which are subdivided into two. Each subdivision indicates 500 plunges of the dipper into the mercury, and when the indicator has passed once round the dial 15,000 plunges, or "makes" and "breaks" of the primary current are recorded. The dipper is adjustable and is fixed so that it will plunge 1 cm. into the mercury and the speed of the break is regulated so that it will give about 1,000 plunges per minute.

A special stand to hold the tube has been made for me by Mr. Alfred Dean, to whom I am indebted for many valuable hints in its construction. The accompanying illustration (p. 619) will serve to show its structure. It consists of a wooden upright stand inside which is fitted a series of three wooden frames, in the central one of which a modification of the London Hospital Shield of lead glass is fixed to hold the tube. These frames are fitted with hinges and a pivot in such a manner that the shield can be moved in any direction required. To the opening in front of the shield lead glass cylinders of diameters varying from 11 cm. downwards are fixed. These are of such a length that when the patient's scalp is placed against the mouth of the cylinder, it will be 15 cm. distant from the anticathode. A maximum diameter of 11 cm. is chosen because beyond that the rays become blurred, and it is of primary importance to have as uniform an exposure of the whole area exposed as possible. At the junction of the shield and the cylinder a small metal disc is adapted to hold the platino-barium cyanide pastille, which can be removed at any time during the exposure to compare it with the standard tint. On the left column of the stand Dean's modification of Benoist's radiometer on a sun and planet system is fitted to ascertain the quality of the rays. Two horizontal arms are fixed towards the top of the stand, from which glass protecting screens hang down. On the left arm a Villard's soupape is placed to impede the reverse current from the tube, and on the right arm a milliamperemeter to indicate the current going through the tube. Besides the meter a lever is fixed at the angle between the right arm and the column, which works on a quadrant divided in centimetres, and adjusts the spark-gap between the two poles situated at the ends of the arms so that when the lever is moved down to say 10 cm. on the quadrant, it means that a spark-gap of 10 cm. has been interposed. These various instruments are all connected in circuit. To produce the defluvium at one sitting the following conditions are adequate: (1) a tube of such tension that the rays from it show 3 to 4 degrees of penetration as indicated by the radiometer; (2) a spark-gap of about 10 cm.; (3) a current of about two-fifths of a milliamperè in the secondary circuit; and (4) about 16,000 interruptions of the primary current. Before exposing the scalp, the tube is regulated to fulfil the above conditions, and an exposure is then given, which is continued till the indicator on the speed-counter records 16,000 interruptions, the pastille being examined occasionally to avoid going beyond the required tint, and the state of the tube being kept as constant as pos-

sible during the exposure by means of the regulator and the resistances.

All this may seem to be complicated and perhaps unnecessary, but a permanent alopecia is a serious thing, and it is wise to take every precaution to avoid it. To depend entirely on the pastilles, though they have proved so reliable, does not seem to me to be advisable, as it is not inconceivable that while adjusting them they may accidentally have become damped or be otherwise altered, and give a false reaction time in consequence. Besides, by the above arrangement it is possible to prescribe so many discharges from a tube, the tension of which is kept as constantly as possible of the required degree for any special therapeutic purpose, with the amount of current passing through the tube also kept under control.

I have described this apparatus at some length, not because it professes to be anything more than an adaptation for specific purposes of several well-known appliances, but rather that others interested in the subject may improve upon it, so that in the end we may have an x -ray apparatus and a system for therapeutic purposes which will enable us to prescribe an accurate dosage of rays of a desired type, and give us a definite standard by which the results of different observers may be compared.

THE RECENT CHOLERA EPIDEMIC IN PERSIA,

1904.

By JOSEPH SCOTT, M.B., C.M.,

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Previous Epidemics.

An epidemic occurred in Teheran in 1861, reappearing in a milder form in the summer of 1862. From the autumn of that year Teheran was free from cholera until the summer of 1867, when a very severe epidemic broke out; this is the only epidemic which is known to have come from the west by way of Tabriz. Cholera reappeared each succeeding summer until 1872; subsequently Teheran remained free, but it was occasionally reintroduced from other parts of Persia. In 1889 cholera again appeared, following the pilgrim route from Mesopotamia via Kermanshah and Hamadan, but stopped

Sketch showing how the quarantine posts of Pai-Tak, Mahidasht, and Bisutun were evaded.

The quarantine station of Kasr-i-Shirin could not be evaded, but pilgrims often forced their way through.

Quarantine posts on the roads from Kangavar to Teheran were in all probability established too late to be of any assistance in preventing the contagion from spreading.

Q. Quarantine.

short at Koom. In November of that year, after a heavy fall of snow, the epidemic ceased. Cholera again appeared in 1892 in many parts of Persia. Cholera has frequently visited Kermanshah, as is natural seeing that it is located on one of the great pilgrim routes.

Early in April, 1904, I was deputed to go to Kermanshah to investigate the outbreak of cholera there. At the beginning of the year cholera was reported to have broken out at Kerbela, the great pilgrimage town in Mesopotamia where thousands of Persians and other Mohammedans of the Shia sect pass a few months every year. Quarantine, which had been established at Kasr-i-Shirin, near the Turkish frontier, against arrivals from Turkey, was abolished on January 21st for all persons having already undergone quarantine at any of the cordons established by the Turkish sanitary authorities;

with a greater daily mortality, in contrast with the late epidemic, which was introduced from Bagdad about March 14th; the daily mortality was never very great, but a steady cholera death-rate was maintained. One feature of the late epidemic was that females were proportionately attacked more frequently than males.

Water Supply.

Most of Kermanshah is supplied from the springs of Sarab district, about three miles distant from the town; unfortunately the water runs in an open channel, and is liable to contamination from several villages built on the slopes of the stream.

Wells are uncommon except in the Maidan Mollah Abbas Ali district; none exist in Shahr-i-No. The tanks of the different houses are mostly connected with each other, the

Sketch showing how quarantine posts in the immediate vicinity of the town of Kermanshah were avoided. To enforce quarantine regulations a very strong military cordon would be required. Q. Quarantine.

all other arrivals had to submit to twenty-four hours' observation. In March a muleteer on his way from Bagdad to Kermanshah was taken ill on the road and died on his arrival at the latter place. Several other cases occurred in the pilgrims' quarter, and, probably through Jewish women having bought clothing and bedding belonging to cholera patients, the contagion spread to the Jewish quarter. Strong measures were then taken; the town was put in as good a sanitary condition as possible, and disinfection of the infected houses was carried out under the supervision of Government officials. The Customs officials (Belgians) were entrusted with the management of the quarantine, and stations were established at Kasr-i-Shirin, Mahidasht, and Bisitun (see map).

Previous epidemics have generally lasted a shorter time,

water flowing from house to house; it is not difficult to conceive how a waterborne disease like cholera can thus be spread, especially in a country where the house tank is utilized for washing almost everything used in the daily routine of life.

Sewers.

Kermanshah is unique in that a large part of the town has a system of sewers; unfortunately in the lower-lying parts of the town they are not covered in, thus becoming a public nuisance; they are very objectionable, especially in the summer months, when water is scarce; part of the sewage water is used in the cultivation of vegetables, but the greater part drains into the Karasu river.

Sanitation.

Houses are generally overcrowded and unhygienic, as many as seven or eight people living in a single-roomed house.

Cholera Hospital.

An old caravanserai was set apart for this purpose. Only the poor and destitute were received as patients; it was of little real utility.

Breakdown of Precautions.

The sale of fruit in the bazaars was for a time prohibited by the Governor of the province. Measures which could have stopped the epidemic and have prevented its spreading to other provinces—such as cleaning the town, disinfecting the houses and clothing of patients and contacts, notification of cases, free distribution of medicines and disinfectants, etc.—although originally started, fell to the ground through weakness on the part of the Governor in supporting these measures because of the protests of a few bigoted and discontented persons against the innovations of the European doctors.

On April 20th and 21st a demonstration was made against the European medical officers who were entrusted with carrying out protective measures in Kermanshah, it being rumoured that the outbreak of cholera was a fiction and that the doctors had poisoned the town water supply. From this date onwards all sanitary precautions in the town were abandoned.

Origin of the Epidemic.

Cholera had practically disappeared, when Aga Fazel Mamegani, one of the leading high priests of Kerbela, who was proceeding on a pilgrimage to Meshed with a large following, broke through the cordon at Kasr-i-Shirin, and was allowed to enter, remain in, and leave Kermanshah without submitting to any quarantine regulations. On May 8th, the son of one of the Mullahs of Kermanshah having died from cholera, a sudden panic took place, and about one-third of the population left the town, camping under trees or in tents near villages. From this date the infection spread through the whole district, and whilst the mortality seems to have been very great in some villages, as in Hadjiabad, where out of a population of 250 souls 40 or 50 fatal cases occurred, in others it was limited to one or two deaths. Finding the district as bad as the town, people began to return on May 30th.

Aga Fazel again broke through the cordon at Kangavar, which had been isolated, being infected, and from the time of his passage through Kangavar one traces the spread of the contagion along the high road from Kangavar to Koom and Teheran, and along the road from Kangavar to Hamadan and towards Azerbaijan.

The first case of cholera in the town of Hamadan occurred shortly after the arrival of Aga Fazel, who preached against the faithful being prevented from visiting the sacred shrines, and described the quarantine measures as innovations of the "Feringees."

In Hamadan the disease broke out in the beginning of May, and in the village of Kabudrahang alone 80 cases and 50 deaths were reported during the space of sixteen days. The mortality in Hamadan is said to have reached at the end of June 100 a day. At about the same time a serious outbreak of cholera in Malayer, Tusirkan, Nehevend, Doaletabad, and Burujird was reported.

Kurdistan was for some time kept free from cholera, most stringent quarantine regulations having been enforced on the road from Kermanshah to Senneh, Kurdistan. The epidemic however, reached Senneh from Penjwin, in Turkish territory.

Quarantine.

Theoretically quarantine should be an efficient protection against cholera being introduced into a community; practically it is a failure, notably as carried out in the province of Kermanshah. Quarantine regulations can be of little use unless they are stringent and thoroughly carried out. Unfortunately the temptation to evade such regulations is in proportion to their stringency. It is impossible to secure the absolute honesty and efficiency of every individual in a large body of poorly-paid soldiers charged with the carrying out of the details of a system which entails great personal inconvenience, and loss to travellers and merchants. Therefore if the strength and usefulness of the quarantine chain is to be measured by its weakest link, a very slight acquaintance with its working will prove how very weak it is. Even if the utmost care, honesty, and intelligence succeed in excluding individuals suffering from or likely to suffer from cholera, there is no guarantee that the germ of the disease may not be introduced. It is impossible, short of absolute and complete

isolation, for any practicable system of quarantine to deal with such cases. Ordinary quarantine, in my opinion, instead of proving a defence, may actually increase the risks of an epidemic; it fosters a sense of false security and neglect of the first principles of public health—pure water, good food, etc. No attempt was made to isolate the different arrivals, or disinfect clothing and personal effects of cholera patients, pilgrims, and travellers; regulations were evaded and cases were concealed.

The accompanying maps show how easily muleteers and travellers evaded the different quarantine posts. The march of the epidemic can be traced through the plain of Irak with its multitude of villages, on to the great shrine of Fatima at Koom, and so on to the capital. From Koom the epidemic worked its way south to Kashan and Ispahan. From the capital it gradually spread to Meshed in the east, Resht and Tabriz in the north-west. Dr. Vaume, of the Turkish Sanitary Board, who was entrusted with the supervision of the quarantine measures, succumbed to the disease. Nomadic tribes scarcely suffered, whilst villagers suffered heavily, which is not to be wondered at, as Persian villages are most insanitary. Trade was completely paralysed for a time, and the Customs receipts fell considerably. Every pilgrim carries a leather bottle containing water when on the road, and is never very particular where he fills the same. At Koom the bodies of cholera patients were washed in the river which flows close to the great mosque, the same water being used for domestic purposes. It is estimated that from 50,000 to 100,000 pilgrims pass Kermanshah yearly en route to Kerbela, Nejed, and Kazimein.

On entering Turkish territory at Khanekin pilgrims are subject to a quarantine tax of 10 piastres, gold. Corpses, of which a great number are annually sent to Kerbela for interment, pay a tax of 35 kranas to the Turkish authorities in Kermanshah, and a further tax of $\frac{1}{2}$ L. Turkish at Khanekin. A permanent quarantine post is maintained at Khanekin by the Turkish Sanitary Board to supervise the traffic and examine the bodies.

Statistics.

From figures supplied by the Minister of Customs and Posts the approximate mortality is given, and is generally conceded as much underestimated.

Provinces.			Provinces.		
Kermanshah	...	5,000	Mazanderan	...	2,000
Hamadan	...	3,000	Khorasan	...	5,000
Irak	...	1,000	Ispahan	...	2,000
Tusirkan	...	1,500	Shiraz	...	15,000
Koom	...	1,000	Arabistan	...	2,000
Teheran	...	20,000	Azerbaijan	...	8,000
Kazvin	...	200			
Gilan	...	3,000	Total	...	68,700

Recommendations.

In order to prevent further outbreaks and protect Persia against returning pilgrims, the following precautions are, I think, necessary:

The provision of a permanent camping ground at Kasr-i-Shirin, where pilgrims would be housed in large corrugated iron sheds, the ground being at some distance from village and oil works. Such a camp should be furnished with the latest sanitary arrangements; sufficient latrine accommodation should be provided, the water supply being pumped from the river bed and stored in a cistern, and from thence supplied by means of pipes on the tap system; in this manner the water supply would be safeguarded; a special washhouse provided and the ground drained. No great difficulty should attend the carrying out of the above measures, as Kasr-i-Shirin being a frontier Customs post, a permanent Customs staff already exists.

RATS IN RELATION TO PLAGUE.

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II.

THERE have been periods when in India rats have proved themselves most destructive to the crops; in ordinary seasons their destructive proclivities are sufficiently trying to the agriculturist, but in some years their depredations call for special remark. Thus, in the Bombay Agricultural Report for 1895-6 we read that rats were in such large numbers in Karachi and Hyderabad that rewards were offered for their capture (p. 24). But the most interesting among several