

EPIDEMIC PAROTITIS

by

Dorothy C. Knowles

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Approved by:

Noble P. Sheward

Instructor in Charge

Noble P. Sheward

Head of Department

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## Epidemic Parotitis.

Epidemic Parotitis is chiefly a disease of childhood. It is characterized by an inflammatory enlargement of the parotid gland of one or both sides. The submaxillary and sublingual glands may be at the same time involved. The gland swells, there is a serous exudate, and the tissue is tense and painful. There is often edema of the mucous membrane, and of the pharynx. MacFarland(1) says, "All indications suggest that suppuration is imminent, yet this stage of the inflammatory process is rarely reached." After a few days the exudate is absorbed, and the patient recovers.

Epidemic Parotitis, otherwise known as mumps or clown's disease, is probably a great deal more serious than it is usually considered. Children are usually only slightly affected, being ill only a few days, and experiencing little inconvenience except a local tenderness, most marked while eating. The literature, however, is full of references to various complications of this disease, so simple in itself.

Without doubt, the most frequent complication of mumps is Orchitis. In their article on "Orchitis from mumps" Ballenger and Elder(2) estimate that "Orchitis follows mumps in ten to twenty-five percent

of the cases, and in about half of these, atrophy results." In a limited number of cases they have had success in incising the tunica albuginea, thus allowing the serous fluid to escape. They consider that the atrophy results from pressure necrosis due to the inelastic tunica albuginea's preventing the testicular substance from swelling in response to the inflammatory process.

Metastatic Orchitis frequently precedes mumps. Torpey(3) mentions a case under his observation in which a young man, eighteen years of age, complained of swelling in the left testicle. It was swollen about twice the normal size, and was tense and painful. In a few days the other side was likewise affected. Tuberculosis, gonorrhoea, and lues were excluded as causes by the usual tests. In about a week there was a swelling of the jaws, and a classical case of mumps developed. He concludes that the swelling of the testis must have been due to a reversal of the usual phenomenon of metastasis. Waddelow (4) reports a case of primary epididymis. Maidlow(5) observed orchitis and female pelvic disorders some days before the parotid swelling. Musser(6) mentions

a case in which orchitis developed, almost undoubtedly due to the etiological factor in mumps, since other members of the family at the same time had parotitis, in which there was never any swelling of the parotid gland. He says, "Metastases prove that the testicle is almost as liable as the parotid to infection." Chambers(7) tells of his "observations on mumps in the adult male with involvement of orchitis without that of the salivary glands."

Kaunitz (8) gives as less frequent complications of Parotitis: meningitis, neuritis, ovaritis, endocarditis, arthritis, nephritis, mastitis, and vulvovaginitis. He personally spent considerable time on mumps meningitis, and reports three cases under his supervision. He considers that while meningeal symptoms are probably slight in most cases, they are usually present in a mild form. He describes the pathology as "a serofibrinous meningitis, in some cases invading the brain tissue and the nerves at the base of the brain." The cytologic and chemical tests of the spinal fluid are typical of an inflammatory process in the meninges. The symptoms resemble those of the meningitis of Tuberculosis, but the course of the disease is very

different. Diagnosis is not difficult. The coincidence of mumps is suggestive. Most other inflammations of the meninges, other than Epidemic Meningitis, are chronic, and need not be considered. While there is usually a high temperature in Epidemic Meningitis, Mumps Meningitis usually has little or no fever throughout. There are many mononuclear cells, sometimes as many as ninety-nine percent, in the spinal fluid, which is clear or opalescent, and not cloudy. Most patients recover spontaneously. There may be atrophy of the auditory and optic nerves. The gravest forms are those affecting the vital centers, as of the medulla. Early lumbar puncture is very valuable. Dixon(9) reports a case of parotitis resulting in meningitis, and Haden(10) describes cerebral complications in mumps.

There have been many cases of labyrinthitis and internal ear deafness reported as due to mumps. Boot(11) reports two cases of deafness due to non-suppurative involvement of the labyrinth in the course of mumps. Willcutt(12), Weinstein,(13) and Wilson,(14) all report cases of labyrinthitis during mumps, resulting in internal ear deafness.

Hunt,(15) and Friedstein(16), cite cases of hemorrhagic nephritis complicating mumps. Edgecombe (17) and Maidlow (18) had cases with very marked gastro-intestinal, probably pancreatic, disturbances, and Gilhespy(19) reports grave Diabetes Mellitus following mumps.

#### INVESTIGATIONS OF ETIOLOGY.

Studies dealing with the etiology of Parotitis are comparatively few. Investigations by workers have followed two general lines, namely: that the etiological factor of Parotitis is either a diplococcus, or a filterable virus.

Early investigators in France and Germany, and later in America, obtained results leading them to consider a diplococcus to be the cause of the disease. Laverin and Catrin(20) in 1893 reported that they found a diplococcus in a large proportion of cases in the exudate from the parotid gland. In 1896 Macray and Welch(21) examined the saliva from Stenson's duct in ten cases, and found a diplococcus in six of them. In eight blood examinations the organism was found in pure culture three times, mixed with Staphylococcus three times, and twice results were negative.

In 1907, Korentschewsky(22) published a paper in which he stated that he had found a diplococcus in the exudate in twenty-one cases out of twenty-nine, and that he had obtained a similar organism in the blood in eight out of thirty-two cases.

Isabella Herb(23) in 1909 reported that she had isolated a diplococcus from the body of a man who had died in a hospital soon after arriving. His case had been diagnosed as Epidemic Parotitis by the attending physician. Postmortem revealed right suppurative parotitis, broncho-pneumonia, and several minor lesions. From the lung, testicle, cerebrospinal and pericardial fluids, bile and parotid gland, a diplococcus was isolated. She described this organism as occurring mostly as diplococci, with occasional Streptococcus forms, and small groups. It stains easily with all anilin dyes, is Gram-positive, and from 0.5-1.5  $\mu$  in diameter. It has no capsule, spores or flagellae, and produces no gas or indol. She found that mice, rats, guinea-pigs and rabbits, injected subcutaneously or intraperitoneally, died of peritonitis in twenty-four hours. Rabbit testes, inoculated with the diplococcus, developed an acute inflammation in seven to ten days, with, however, no suppuration. The gland seemed perfectly well and normal within a couple weeks, while those inoculated with Staphylococcus

or Streptococcus died of peritonitis in twenty to twenty-four hours. A monkey inoculated by Miss Herb through the right Stenson's duct, had temperature and an enlarged gland the next day. In four days the inflammation had noticeably subsided. For the most part Miss Herb worked with dogs. After direct inoculation into the parotid gland there was swelling lasting seven to ten days. For a few days the gland would enlarge, and then gradually return to normal.

Since 1908, quite a bit of work has been done with a filterable virus as a possible cause of the disease. Granata(24) used a filtrate of a patient's saliva for animal inoculation. His work, and that of his followers has tended towards an attempt to reproduce the disease in animals, rather than to isolate the etiological factor from the patient. He was the first to conclude that the virus may be filterable. His conclusions were based on the results that he obtained from inoculating sterile saliva filtrate from two patients into the blood, gland, and subcutaneous tissue of rabbits. The animals inoculated intravenously had a rise in temperature lasting from three to four days, and from the

gland inoculations he obtained a swelling lasting from one to two weeks.

Working at the Laboratory of the Rockefeller Institute for Medical Research on a filterable virus as a possible factor in Parotitis, Martha Wollstein, (25) in 1915 published her results. She used sterile salt solution to rinse the mouths of her patients, and filtered the resulting fluid through a new Berkefeld candle. The clear filtrate was tested aerobically and anaerobically for sterility, and if sterile, one cubic centimeter was injected into the parotid gland and testis of cats. In six to ten days there was a tenderness in the glands and a leukocytosis beginning two days after inoculation and reaching the maximum in seven to fourteen days, coinciding with the height of the fever. She describes the swelling as never reaching the stage of marked facial asymmetry. In 1918 she published a paper reporting further work, which merely confirmed her previous findings.

The object of the present paper is to report on investigations on Epidemic Parotitis along the following lines:

1. The Bacterial Flora of the mouth of Parotitis patients, with special reference to the diplo-

coccus described by Herb.

2. The morphology and cultural characteristics of the diplococcus isolated from the Parotitis patients, studied by the latest methods.
3. The clinical features of Parotitis, correlating them with the blood picture.
4. Animal experimentation with the diplococcus, correlating the pathology of the infection in lower animals with that of humans.
5. Agglutination of the diplococcus by the serum of convalescent patients, and by the serum of the infected animals.

From an epidemic among the University students at Lawrence, Kansas, I have been able to obtain a great deal of material for work on Parotitis. From all of my patients I have taken cultures from the papillary opening of Stenson's duct into the mouth. With the swab I have inoculated dextrose blood agar, and incubated it aerobically and anaerobically. On practically all of the patients I have taken both total and differential leukocyte counts, and in as many cases as possible I have taken blood aseptically from a vein to use for blood cultures or agglutination tests. The table on page 10 gives a brief summary of

Table L. SUMMARY OF PAROTITIS CASES.

Name	Tot. Leuk. count	% Mono nuc.	% Poly morph	Dip. isol.	Temp. at time.	No. days
Posey	5800	30	66	none	101.6	3
Murphy	9600	24	73	none	106	7
Brauer	9000	33	64	none	99.8	1
Davis	8000	47	50	some	98.6	4
Moore	7200	44	54	some	98.4	3
Leitch	8800	54	42	many	101	1
Hanna	7400	52	43	some	98.6	1
White (F)	6000	51	45	some	99	2
Butler (F)	4800	43	54	few	98.6	3
Ingalls (F)	5000	45	53	many	98	1
Mader	5600	44	53	many	98.8	1
Roscoe	7000	51	46	many	103	1
Flint	-----	--	--	some	98.6	1-4
Flint	-----	--	--	none	98.6	4-7
Burton	-----	--	--	none	102	6
Crane	7200	45	52	none	98.8	4
Doornbos	7600	47	49	few	98.6	3
Loudin	7600	47	48	many	98.4	1
Cavanaugh	7000	48	48	many	98.4	1
Solomon	7400	41	54	many	98.6	1
Collins	7400	46	52	many	98.6	1
Dillan	6800	44	53	many	98.6	1
Scott	7800	37	59	many	101.8	1
Lippke	7600	41	55	many	102.4	1
Treece	-----	--	--	few	---	1
Sturton	7800	46	50	many	101.6	1

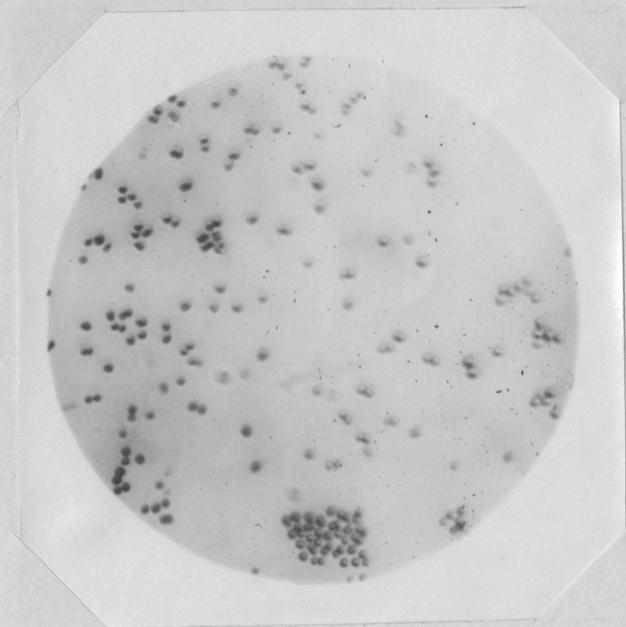
the cases.

### BLOOD PICTURE

The blood counts were quite consistent. In no case did the leukocyte count exceed ten thousand. There seemed to be no marked leukocytosis in any case. There was, however, a consistent change in the differential leukocyte count. In almost every case there was a relative increase in mononuclear cells. The number of mononuclear cells in most cases varied from 43-54 %, with a mean average of 50 %. There were very few cases in which this blood count was not typical. The variations were usually in cases of high temperatures with complications. In general the temperature did not go much above normal. In only a few cases was it above 100 degrees F.

From my results I should conclude that the leukocyte count is not materially changed in Parotitis, but cases of high temperature and leukocytosis may mean metastatic infection of some part of the body other than the salivary gland. The most characteristic thing about the blood picture in Parotitis is the relative increase in mononuclear cells.

DIPLOCOCCI.



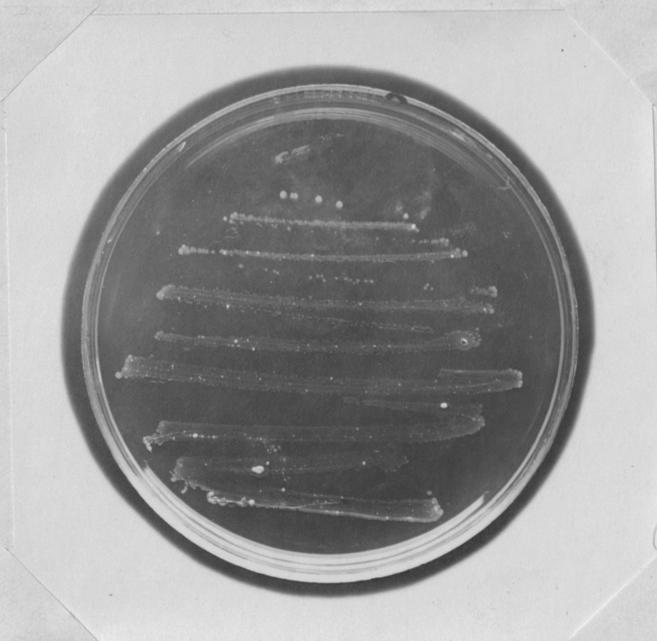
13.

DIPLOCOCCI

Growth in Gelatine.



Growth on Agar.



## ISOLATION OF DIPLOCOCCUS

The cultures that I have taken from Stenson's duct have given me very interesting results.

In twenty out of twenty-six cases, I have isolated a Gram-positive diplococcus, twelve times practically in pure culture. In eleven control cases I failed to obtain a similar organism from people with no symptoms of Parotitis.

Of the six cases from which I did not isolate the diplococcus, five were of four or more day's duration. In several cases I received a very mixed flora from the duct. These were mostly cases of two or more day's duration. In twelve cases I received Practically a pure culture directly from the gland, and these were cases of twenty-four hour's duration or less.

## MORPHOLOGY AND CULTURAL CHARACTERISTICS

This Gram-positive organism which I isolated seems to be the one that Herb describes. It occurs almost always in diplococcus formation, and although it varies considerably in size, it is never as large as *Staphylococcus aureus*. It produces acid with no gas in dextrose, but does not ferment lactose, saccharose, mannite, salicin, inulin, xylose, arabinose, or maltose in Hiss serum water. It

produces no apparent change in milk, and does not liquify gelatine in two weeks, but grows in it in a characteristic beaded fashion.

Lead acetate is not blackened by it, and indol is not produced, although nitrates are broken down to nitrites by the diplococcus. The organism is a facultative anaerobe. It will grow equally as well in the presence of oxygen and without it.

The diplococcus grows best on dextrose blood agar. It may be cultivated on plain agar after isolation, but it is practically impossible to isolate it from the mouth on plain agar, because of its scanty growth on ordinary media. Sterile saliva, mixed with plain agar in final concentration of ten percent, makes a fairly satisfactory media. On all media the growth is characteristic. The colonies on blood agar are considerably larger than the colonies of *Streptococcus*. They are not nearly as large as *Staphylococcus*, however. Unless the media is very heavily seeded, the colonies even on a slant tend to grow in distinct colonies. These colonies are glistening, and have a slightly yellowish pigment, and a very gummy consistency.

In forty-eight hours the colonies have a hard and wrinkled surface. In broth the growth consists of a sort of a precipitate of large clumps of bacteria which settle to the bottom of the tube. In dextrose broth, besides the precipitate there is a slight clouding.

The optimum Ph value of the media for these organisms which I isolated was 7.4 . At this Ph value the growth is characteristic. There are many small individual colonies which do not run together, and which have a very tough scum-like consistency. Growth is good on media with Ph values between 6.6 and 7.6. The limits at which the diplococcus will not grow are at Ph values of 5.8 and 8.3 .

The diplococcus is not very resistant to environmental conditions. It is killed at a temperature of seventy degrees for one minute, and at fifty-six degrees Centegrade for ten minutes. It will not survive growth twenty-four hours, and will not live more than forty-eight hours in water that has been previously autoclaved. It will not live much more than a week on blood agar kept at six degrees Centegrade, and will live only a few days on

blood agar at room temperature. From these facts it seems as if the organism, if it is the causal factor in Parotitis, must be transferred almost by direct contact.

#### ANIMAL EXPERIMENTATION

I have inoculated dogs in various ways with suspensions of twenty-four hour cultures of the diplococcus in sterile salt solution.

Inoculations into Stenson's duct through the mouth were unsatisfactory. Intravenous injections also gave no results. Injections into the gland directly or subcutaneously anywhere into the throat tissue gave consistent results on all of the six dogs inoculated this way. There was an acute and uniform, localized swelling in the salivary gland, it sometimes being five or ten times the normal size. In no case was there suppuration. The following is a brief summary of the individual experiments on dogs.

#1 Small dog. Inoculated through the opening of Stenson's duct into the mouth with 1cc. of a rather heavy suspension of a twenty-four hour culture of the diplococcus.

Temperature on next day, and on following days for two weeks remained 101 degrees F. which is about normal for dogs. There was never any noticeable swelling of any of the salivary glands.

#2 Small dog. Inoculated same way as #1. No results.

#3 Same as #2. No results.

#4 Dog inoculated intravenously into the saphenus vein of the leg with 1 cc. of a similar culture.

In twenty-four hours there was a temperature of 102.8 F. The tissue around the site of inoculation was red and swollen. There was no suppuration then or at any later time. In about a week the leg had practically regained its normal condition. There was never any noticeable change in the salivary glands.

#5 Dog inoculated with 1 cc. of a suspension in sterile salt solution of a twenty-four hour culture of the diplococcus directly into the submaxillary gland from the outside.

Temperature at time of inoculation found to be 101.5 degrees F. A blood count taken before

inoculation showed 8000 leukocytes per c.mm., with a differential count of 61% polymorphonuclear cells, and 36% mononuclear cells.

Temperature next day was 102.4 degrees F. Leukocyte total count was 22,000 per c.mm.; with a differential count of 86% polymorphonuclear cells, and 10% mononuclears. A culture of the saliva was taken, and diplococci isolated from it.

Two days from inoculation the temperature was 103 degrees F. and the gland was swollen even more than the day before. The leukocyte total count was 24,200 per c.mm. with 70% polymorphonuclear cells, and 26% mononuclear cells.

On the third day the total leukocyte count was 18,800 with 64% polymorphonuclear cells, and 33% mononuclear cells. The gland seemed to be the same as the day before.

Temperature was 102 degrees F.

The fourth day from inoculation the gland was noticeably decreased in size. The temperature was 101.5 degrees F. Leukocyte total count was 16,400. There was 58% polymorphonuclear

cells and 39 % mononuclears.

On the fifth day the temperature was 101.5 degrees F. Leukocyte count was 12,800 with 60 % polymorphonuclear cells, and 37 % mononuclears.

The sixth day the gland was almost its normal size. The temperature and blood count was practically normal again also, with a total leukocyte count of 9800 and differential count like the preceding day.

In ten days the gland was apparently as normal as the uninoculated one.

#6 and #7 were inoculated the same way as #5 and results are given in the following table.

#8, #9, and #10 were inoculated with a similar suspension of the diplococci, but the inoculation was subcutaneously into the throat in the region of the submaxillary gland, and not directly into the gland. As in the other cases the swelling was localized in the gland, and was of the same uniform and non-suppurative type. In each cases the swelling increased for forty-eight hours, and then gradually decreased until in 7-10 days the gland was normal again.

Table 2. RESULTS OF ANIMAL EXPERIMENTATION  
DOG.

No. Dog	1	2	3	4	5	6	
24 hrs.	Temp.	102.8	102.5	102.9	105	102.6	103.6
	Tot. leuk.	22400	16800	20000	20000	30000	26800
	% Polymorph.	86	79	74	77	76	84
	% Mononuc.	10	17	22	19	21	13
48 hrs.	Temp.	103	102	102.6	103	102.8	103.2
	Tot. leuk.	24200	16000	18400	16400	24400	21800
	% Polymorph.	70	66	58	60	62	76
	% Mononuc.	26	31	39	37	34	21
3 days	Temp.	102	101.7	102	102	101.5	102.5
	Tot. leuk.	18800	12600	14400	15800	18400	16000
	% Polymorph.	50	54	56	60	56	59
	% Mononuc.	33	42	42	37	41	37
4 days	Temp.	101.5	101.5	101.2	101	102	102
	Tot. leuk.	16400	8800	10600	11800	9600	12600
	% Polymorph.	58	58	60	58	61	57
	% Mononuc.	39	37	36	37	36	40
5 days	Temp.	101	101.2	101	101	101.6	102
	Tot. leuk.	12800	8600	9800	10400	8300	9800
	% Polymorph.	60	62	62	60	58	61
	% Mononuc.	37	35	34	36	39	35
6 days	Temp.	101	101	101.2	101	101.3	101.8
	Tot. leuk.	9800	8000	9400	9800	8800	9000
	% Polymorph.	60	65	61	64	64	64
	% Mononuc.	37	31	35	32	33	33

This enlargement of the gland regularly caused an acute leukocytosis in twenty-four hours, varying from 15,000-20,000 leukocytes per c.mm. At this time the differential leukocyte count showed no apparent change. The dogs seemed to be but slightly affected generally by the infection of the gland. The rise in temperature was usually from one to one and one-half or two degrees F. They seemed to have slight difficulty in eating, and whined when the gland was touched. Cultures taken from the fluid aspirated from the gland of one of the dogs proved to be pure cultures of the diplococcus. In three cases the diplococcus was isolated from the saliva in the mouth of the dogs.

In forty-eight hours there was no apparent change in the physical appearance of the gland. The temperature was usually slightly lowered, and the differential leukocyte count in forty-eight and seventy-two hours showed a relative slight lymphocytosis of forty to forty-four percent. Blood counts and temperature readings were taken on all dogs before inoculation, and the

average leukocyte count was found to be 8000. There was an average percentage of polymorphonuclear cells of 61, and of mononuclear cells of 35 in normal dogs. The normal temperature was about 101 degrees F.

After seventy-two hours the gland rapidly decreased in size, until in about a week it seemed normal. By this time the temperature and blood counts were also normal. Blood was taken on various days, and the serum kept for agglutination experiments. In three days from inoculation there was a strong agglutination with the diplococcus in final concentrations of the serum of 1:100. In one week from inoculation the reaction was even stronger. Control agglutination tests with the serum of normal dogs were negative.

Rabbit testes inoculated with suspensions of the diplococcus were inflamed and greatly enlarged the next day. The swelling was firm and uniform and showed no signs of suppuration. In five days the gland had regained its normal size.

White mice inoculated intraperitoneally with one-half cc. of a very heavy suspension of a twenty-four hour culture of the diplococcus died in forty-eight to seventy-two hours. Smaller quantities than this did not kill the mice. On autopsy of the mice, inoculated by the organisms, large numbers of the diplococci were found in the peritoneal cavity. The peritoneum was noticeably inflamed, but other than this, there was no noticeable pathology.

The cut surface of the gland removed from one dog that had been inoculated with the diplococcus showed a pinkish serous exudate. Stained sections of this showed an infiltration of mononuclear cells into the ducts of the acini.

#### AGGLUTINATION EXPERIMENTS

From several cases I also isolated the diplococcus from the saliva and sputum. A limited number of blood and urine cultures were negative. Blood taken from the patients at various stages in the course of the disease was used for agglutination experiments. There was difficulty in these experiments, however, due to

the fact that it is almost impossible to make an even suspension of the organisms. By growing them in calcium carbonate broth, shaking the tubes of twenty-four hour growth very vigorously for several minutes, and then centrifugating the suspension at a low rate of speed for a few minutes, the large clumps were thrown down, and a fairly even suspension of organisms obtained. I used this suspension with the serum from convalescents in final dilutions of 1-50 and 1-100, and found agglutination in both these dilutions in a limited number of cases. This reaction was not marked until the fifth to seventh day from onset of symptoms. It was still present, however, in two weeks. In one case there was still agglutination at the end of a month from first symptoms.

In one case I took daily cultures from the exudate of the salivary gland of a Parotitis patient for two weeks with a view to finding the length of time the organisms remain in the mouth. I found

practically a pure culture of the organisms twenty-four hours from onset of symptoms, very few in three days from this, and none on any day after this. The patient had a very light case of Parotitis, the swelling being practically gone in a week from the first symptoms. The average length of quarantine in this country at the present time is two weeks. It is interesting to note that in 1905, Douglas (26) medical officer in a British preparatory school, insisted on a quarantine of twenty-nine days since he considered that the then recognized length of quarantine of twenty-five days was insufficient.

#### SUMMARY AND CONCLUSIONS

1. The organism that I have isolated seems to be identical with the diplococcus found by the early workers and described in detail by Herb.
2. In twenty out of a possible twenty-six cases of Parotitis, I have isolated a Gram-positive diplococcus. Twelve times, all twenty-four hours or less from onset of symptoms, this organism has seemed to be in

pure culture when taken directly from the duct opening into the mouth. Of the six cases giving negative results, five were cases of four or more day's duration. In no case did I find this organism in the mouth of normal persons.

3. I have also found this diplococcus in the sputum and saliva of patients, but failed to find it in a small number of blood and urine cultures that I obtained.
4. The diplococcus being isolated from such a large proportion of cases examined, and not in any normal person, leads one to suspect that it has something to do with the disease, Parotitis.
5. Suspensions of this diplococcus inoculated into the submaxillary gland of dogs, or the subcutaneous tissue around the gland, always produces a uniform swelling with no suppuration, which reaches its maximum in forty-eight hours from time of inoculation. In twenty-four hours from the inoculation there is an acute leukocytosis of 16,000-30,000, with very little change in the differential count. This total leukocyte count

quite promptly returns to normal in about a week. In four days the differential leukocyte count has gradually changed to a relative lymphocytosis of 80-44%.

6. Thus, the infection produced in the dogs inoculated was similar to that in persons having Parotitis in that it was uniform in swelling, never led to suppuration, caused a lymphocytosis in three or four days from inoculation, and never induced a rise in temperature exceeding two degrees.
7. Cultures from the saliva of the inoculated dogs yielded the diplococcus in three cases out of six. In one case fluid aspirated from the swollen gland of one of the dogs gave a pure culture of the diplococci.
8. Suspensions of the diplococci in sterile salt solution inoculated into rabbit testes caused an acute inflammation in twenty-four hours which had entirely subsided in less than a week.
9. Large doses of the diplococci killed white mice in twenty-four to seventy-two hours, the mice apparently dying of peritonitis.

10. The blood serum of convalescents and of the inoculated dogs agglutinated suspensions of the diplococci in final concentration of 1-100. Controls with normal serum were negative.
11. The fact that this organism is agglutinated both by the patient's serum, and by the serum of the inoculated dogs seems to show that it is in some way a factor in the infection.
12. The characteristic blood picture in Parotitis is a relative lymphocytosis of 44-53%, with little or no change in the total leukocyte count. In cases of metastatic infection of some part of the body other than the salivary glands, there may be a slight leukocytosis with an increase in the relative proportion of polymorphonuclear cells and with exceedingly high temperature. In ordinary cases the temperature rarely rises more than two degrees and often remains normal throughout the course of the disease.
13. The diplococcus is a relatively small organism with but slight fermentative powers. It grows well on nearly all media when once isolated, but prefers a media containing some body fluid, and with a slightly alkaline reaction.

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- (23) Herb-J.A.M.A.1908, 11, 668.

(24) Granata-Med. Ital. 1908, vi, 647.

(25) Wollstein-J. Exp. Med. xxiii, 353.

(26) Douglas-Brit. M. J. 1905, 1, 594/