should include the statistical study of the fatality, percentage of complications, relapses, and unfavorable symptoms in the various groups, and the height of fever and duration of fever.

Numerous observations should be made of the appearance and concentration of the various antibodies and ferments in the blood and lymph, if possible, of the various groups in order to understand the mechanism of the immunity produced and to ascertain the best mode of treatment.

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WHAT IS INFLUENZA?

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THE pandemic has shown how little is known of the cause and nature of influenza. If the disease had appeared for the first time in human history it could scarcely have produced greater confusion. If, instead of striking, as it did, like an old enemy, and after flying its warning signals for months before the attack, it had come unheralded and for the first time, it could scarcely have found the world less pre-

pared for it. Nobody seemed to recognize the disease or to know what to do—or what it was useless to do—in order to stop it.

Now that the blow had been delivered it is desirable to see what lessons can be learned from it. It is necessary to be prepared for what may still be in store for us. It is by no means possible that we are done with the disease. It seems to have disappeared for the present, but it may return.

And there is still another and an equally good reason for studying this pandemic. Information gained in connection with the influenza may be valuable in dealing with other respiratory infections. It is unnecessary to say how useful such facts promise to be when it is remembered that respiratory diseases as a class constitute the leading cause of death in most civilized communities under normal conditions.

THE EPIDEMIC ASPECTS.

It is curious to observe how little that is strictly accurate is known about the epidemiological aspects of the disease which has just been prevalent. There is even disagreement as to the identity of what we call influenza. Where it came from, why it struck when it did, as it did, and even the force of the blow, are largely matters of conjecture.

The records now available of many of the city and camp epidemics included in the great outburst are so inaccurate as hardly to warrant a scientific statistical discussion of them. The records of the cases are inaccurate because of uncertain diagnoses and lack of reliable reporting.

The cases which were complicated with pneumonia were reported more correctly than the cases of influenza alone because the diagnosis was more certain, the number smaller and the disease more grave.

The records of death more nearly approach to accuracy than do the records of cases either of influenza or pneumonia. But even here the data are not wholly reliable. During the period of the pandemic, deaths were ascribed to influenza or pneumonia which, under ordinary circumstances, would have been attributed to other causes. And unless the consequences of this pandemic differ from those of its predecessors, many deaths largely attributable to influenza will, for a long time, be reported by physicians as due to other causes. This is likely to be the

case particularly in respect to the less commonly recognized sequelae.

The question of what should be set down as the cause of death where influenza was but one of two or more diseases from which the patient suffered should have received careful consideration in each instance. Attempts have been made to regulate all such questions by rule. The Manual of the International List of the Causes of Death suggests that (1) if one of two diseases is an immediate and frequent complication of another it is the other which should be set down as the primary cause of death. If this rule cannot be followed, the manual proposes that others be applied in the following order, it being understood that as soon as a rule is found which is capable of deciding the matter no subsequently mentioned rule is to be considered; (2) if one disease is surely fatal and the other of less gravity, the former should be stated as the cause; (3) if one is epidemic and the other not so, the death should be ascribed to the epidemic disease; (4) if one is more frequently fatal than the other, the more fatal disease should be given; (5) if none of these rules applies, that diagnosis should be selected which best characterizes the case. In the pandemic only cases which in all probability would have proved fatal without the influenza should not be charged to it.

Had these rules been followed the deaths ascribed to influenza would have been far more numerous than they were. We should not be talking about influenza and pneumonia as though they had been separately epidemic. We should look upon influenza as the essential thing and regard the pneumonia as having been precipitated by the influenza. This seems to be the proper way to look at it and it is so regarded in this paper.

THE THREE WAYS OF IDENTIFYING THE DISEASE.

There are three ways of recognizing the identity of an infectious disease: (1) By the clinical evidence, (2) by the bacteriological evidence, (3) by the epidemiological evidence. Each may be useful; each may be conclusive. In case of doubt, none should be overlooked. Let us consider briefly the light which each one of these three kinds of evidence can throw upon the identity of the disease which has been pandemic.

First, as to the clinical aspects. At the out-

break of the pandemic in September, 1918; a memorandum was issued by the Acting Surgeon General of the Army to all camp and division surgeons, surgeons of recruit depots and independent stations, department surgeons and the air service division, in which the characteristic symptoms of the disease, the probable means of transmission and the steps which should be taken against it were stated. It was believed that the conception of influenza which was inherited from another generation still held good. On this point the memorandum said:

"It is important that influenza be kept out of the camps as far as practicable. To this end it must be recognized as a disease which is distinct and separate from the so-called 'cold,' bronchitis, laryngitis, coryza, rhinitis and from 'fever, type undetermined,' which are continually with us and from time to time become prevalent. The influenza which is now epidemic is not a part of, or a cause of, or the consequence of any of these diseases. It is a specific infection with a characteristic symptom complex.

"The leading symptoms are: Severe headache; chills and chilliness; pain in the back and legs; temperature sometimes as high as 104; great prostration: drowsiness. Occasionally there are nervous symptoms; sometimes, but not always, the eyes and air passages of the nose and throat are affected; there may be gastro-intestinal disturbances. The onset is sudden. The bacteriology is not definitely established: Often the Pfeiffer bacillus can be isolated. The most fatal complication is pneumonia. In most instances the patient recovers in three or four days but is entirely incapacitated for duty while the attack is at its height."

The chief symptoms reported from the camps were substantially as thus outlined. Sudden onset, headache, prostration, fever and injected conjunctivae were reported as the most invariable symptoms. The symptoms of the common respiratory infections of ordinary times were not prominent. Coryza was by no means invariable; in some camps as Kearney, Grant, Johnston, and MacArthur it was unusual. Sneezing was not a reliable sign. Sore throat was uncommon, particularly at some camps, as Lee, Johnston, Lewis, and Beauregard. Generally there was coughing, but this may have been due to the bronchitis which was not improbably independently epidemic.

The most serious clinical feature of the disease was its liability to lead to pneumonia. Had it not been for this tendency, the pandemic might not have attracted much attention. Nearly all who died succumbed to pneumonia.

The pneumonia made its attack and proved fatal, probably because the natural protective mechanism of the respiratory tract was destroyed in some way by the influenza. How, nobody can say. But this was obvious: when a patient was attacked by influenza, his damaged respiratory mucous membrane was unequal to the task of preventing the invasion of germs which were capable of growing in the lung and so causing pneumonia. The result was that some of the pneumonia was produced by one organism, some by another; some was primary rather than secondary and was caused by the influenza virus itself.

Second, with regard to the bacteriology. Some think there was no influenza because the bacillus of Pfeiffer was not always found. Others insist that the Pfeiffer bacillus had nothing to do with the matter: that the disease was due to an organism which has not yet been discovered; perhaps to a filterable virus. From the evidence at hand one is not justified in taking either position. It is unwise in the present state of knowledge, or lack of it, to insist that we have not had influenza because the Pfeiffer bacillus has not always been recoverable.

Third, and finally, with reference to the epidemiology. The disease could be identified by its epidemiology alone. No other respiratory infection is so rapid, or so universal in its spread; none, so far as known, has such a short period of incubation; none is so disabling and so quickly done with; none so completely baffles the efforts made to control it. Rapidity of action characterizes every aspect of influenza.

If influenza behaves as does other infectious diseases, we ought to regard it as possessing the three following epidemiological forms: (1) Pandemic influenza, (2) epidemic influenza, and (3) endemic influenza. The difference between these types depends both upon the activity of the virus and the susceptibility of the individual members of the population who are exposed to it. The evidence, as shown elsewhere in this paper, indicates that influenza probably possesses these three forms.

THE EVOLUTION OF THE PANDEMIC.

Probably nobody will ever be able to say how the highly virulent form of the disease originated or where or when. Inferentially it was developed from a mild infection which was endemic. If this is so, it probably grew in virulence by attacking persons who were especially susceptible to it. Presumably they were susceptible because they had not been exposed to it before. Susceptible visitors to the endemic focus, or travelers passing from such a focus to people who had not experienced influenza, might have furnished the means of its transmission and exaltation.

The exaltation of the virus was probably rapid, not gradual; it developed quickly when all the conditions necessary for it occurred. It probably increased by stages or steps, each representing a state of higher virulence than its predecessor. There may have been one place or many where these changes occurred. Place probably had little to do with the matter; season seems to have nothing to do with it. Social status played no part. The development of high virulence was simply the product of a virus acting in a favorable human environment.

Once the disease had developed into its malignant form, it is not difficult to see how it continued to spread until practically all the susceptible material everywhere was used up. It swept rapidly from place to place, its presence being recognized chiefly by its complications.

The highly virulent state of the virus probably declined as it had increased. As the infective poison met more and more resistant persons, it became more and more reduced in virulence. Finally, the pandemic, which started as a contest between a strong virus and a susceptible population, became a struggle between a weakened virus and an immune population. Then the disease disappeared, so far as its pandemic and epidemic forms are concerned. It could not continue, for it had little to feed on. In this way it returned to its endemic form.

Capacity to undergo marked and rapid changes in virulence appears to be characteristic of the influenza virus. It is perhaps in consequence of this that, under ordinary circumstances, the infective poison is not capable of producing either a great deal of sickness or very severe cases, while from time to time the reverse occurs.

A condition believed to be favorable to in-

crease the virulence is the crowding of many susceptibles together. Crowding favors exaltation by (a) providing short routes of infection, and (b) insuring the transmission of large and repeated doses to many persons. Among a great many some are likely to be particularly effective as accelerators of virulence.

It is easy to imagine how an epidemic wave may be set in motion from a place wherein a virus of uncommon virulence has been produced. It starts when enough force has been gathered by the virus to overcome the resistance of the people among whom it has spread. It is not essential that the highest possible degree of virulence shall be produced in order that a wave shall be started; it is only necessary that a sufficient degree of exaltation shall occur to overcome the immunity which the population possesses.

If this is so, a wave of mild influenza may or may not protect those who experience it from a more severe one. If the difference in virulence is not very great the protection may be sufficient and no wave starts; if it is great and the exposure either excessive or long continued, the immunity may not be enough and an epidemic is set going. It is when a virus which has been for a time restricted is spread to a small group of susceptibles, and has consequently gained a high state of virulence, is suddenly released upon a large susceptible population that the great waves of malignant influenza are produced. In this case it is as though a great deal of energy was accumulated and natural means of defense were not developed.

All this is theory. It is constructed upon biological principles and some observed facts, the whole being put together by inductive reasoning. To hold, the theory must agree with what is known of influenza and it must not contradict any genuinely established fact. It is believed by the writer to answer these requirements at the present time. It is not advanced as a demonstration but as a possible explanation. It is offered as a convenient one to use until a better one is produced.

THE DIFFERENCE IN FATALITY.

Among the most interesting features of the pandemic has been the difference which has occurred in the death rates in the different camps and cities of the United States. No useful data are available for the cities because no reliable

records were made of the cases. The case mortality in the camps varied between 4.5 and 30. The lowest rates were in the southern camps and among those which were attacked last. The highest rates were generally on the seaboard and in the northern and eastern sections of the country. If the invasiveness of the infective agent varied as much as did its virulence there was a great difference in the number of people who were taken sick in proportion to the population in different parts of the world. Upon this point there is little evidence, but such as there is indicates that the disease was much less prevalent in some places than in others.

There is no tracing the disease in its progress over the world from the records of cases or of deaths. It seems not to have traveled east or west, but to have scattered in every direction: It was in Switzerland, England, India, and Brazil, in June, 1918. In July it was in China, the Netherlands, Norway, and North Africa. In August it was reported in the United States, Spain, Greece, and the West Indies. By the end of September practically every state in the Union had been visited. Earlier still, influenza was seen in epidemic form in the United States in March, 1918, and an outbreak in a group of southern army camps was reported by the present writer at that time.* It would not be surprising if many waves had preceded the great and fatal one. Certainly there was a wave of large proportions some months before the main pandemic.

THE QUESTION OF SUSCEPTIBILITY.

What of the occasional cases which followed after the main outburst and what of the secondary outbreaks which, in some places, followed the first? How shall we explain the occasional cases which even now are coming to light after nearly a year? Have all these been influenza? Yes, most of them. Some of the late cases were probably as truly influenza as were the early ones.

The late cases did not occur earlier because the victims were not reached by a sufficiently virulent strain of virus to overcome the degree of immunity which they possessed. Susceptibility played a prominent part throughout the pandemic. It was not only the spread of the virus which determined the course which the epidemic took; liability to infection had quite

* *Journal of Laboratory and Clinical Medicine*, June, 1918, Vol. iii, No. 9, p. 567.

as much to do with the distribution of the cases in point of time and space as did the spread of the infective poison itself. This is a general truth which applies to all outbursts of disease. The intensity and extent of an epidemic is not merely a question of how the virus becomes distributed. The distribution is always greater than the cases indicate. In the epidemic of 1918, the statistics of deaths and of cases merely records the rates at which the susceptibles were reached.

Another view which is advanced in order to account for recrudescences and delayed cases is that the infectious matter did not reach all its victims during the height of the epidemic wave, some being isolated in one way or another until the great mass of cases were over. This theory would be more tenable if it could be shown that some people could live in a thickly settled community and not be reached by a virus of such pervasiveness as that of influenza. Such proof is not to be expected. Influenza travels almost as fast as man can travel, showing that it is highly invasive. It is probable that when an epidemic visited a city everybody came in contact with the virus within a few weeks.

It is remarkable to note how the pandemic showed a preference for a certain age group. Young persons and old were relatively immune. This fact has not been satisfactorily explained. There is a possible explanation which, if correct, clears up more than one mystery connected with the pandemic.

It is possible that those who escaped had had influenza before. The old could certainly have experienced an attack during the known visitation of influenza between twenty and thirty years ago. The young may have had it much more recently; they may have had influenza a year ago, or two years ago. They certainly never experienced the severe form of the disease which swept the country in the autumn of 1918, but they may have been attacked in a mild wave, such as that which is known to have occurred in the spring of 1918. This, and apparently this only, could have rendered them immune.

It is not improbable, then, that the wave of September, 1918, was the culmination of other waves and it is within the bounds of reason to suppose that in these others the young and old, or the young alone, were the ones chiefly attacked. If this seems to argue that the influenza then showed a selective preference it can

be replied that this was to be expected. All respiratory infections show a preference for the young and old.

WAS THE EPIDEMIC A MIXED INFECTION?

Some persons have been solicitous to know how to interpret the reports of influenza which were made during the course of the epidemic. Do they always refer to the same disease? Has influenza manifold aspects? How broad should the definitions of it be?

Some camps preferred not to call their epidemics influenza at all: Some reported that the type changed during the course of the epidemic. Few reported what some persons think to be the fact, namely, that influenza and other respiratory infections existed side by side.

There are two ways of looking at this subject: The first sets influenza down as a group of more or less similar infections; the other regards the whole group as manifestations of the same disease.

The principal diseases of the group whose members are often called influenza are coryza, rhinitis, pharyngitis and laryngitis. Any of these may be termed a cold, or influenza, according to the preference of the physician or the patient himself.

There is a distinct preference for the use of the term influenza. To most persons a "mere cold" is a trifling affair and they do not want to have a disease which confines them to the house called by that name. Few recognize the meaning of coryza, rhinitis, or pharyngitis. To many even laryngitis does not sound especially significant. On the other hand, influenza or grippe is a popular designation. From our experience of a generation ago, most persons know that influenza may be a serious affair, and there are obvious reasons why it is preferred by the laity and by the doctor to any of the other terms, even though it lacks definiteness. From one point of view this very lack of definiteness is an advantage.

As a means of understanding the relative prevalence of influenza, bronchitis, and pneumonia as reported in civil life, it is interesting to consider the following pre-epidemic statistics.

PRE-EPIDEMIC STATISTICS.

Ever since the pandemic of 1889-90, influenza has been supposed to be present in the United States. There have been many restricted and

some moderately pandemic waves reported. In most instances the outbreaks have been fairly local. The disease itself, whatever its identity, has generally been relatively mild. It has not been notably associated with pneumonia.

In the army, what was called influenza was prevalent in 1903, 1904, 1905, 1907, 1908, and 1909. There was remarkably little in 1902 to 1906 and between 1909 and 1914. It has been essentially a winter disease, generally starting from a slight prevalence in December (a rate of less than twenty-five cases per thousand of all troops annually), rising to a maximum in February or March (125 to 175), and falling quickly by April (25) to reach its lowest point (less than 10) in midsummer. In the last twenty years there have been no summer or autumn outbreaks and no recurrent waves such as are characteristic of pandemic influenza. The nearest approach to pandemic pneumonia occurred in 1918, when, after five years of relatively little influenza, there were two periods of prevalence, one in February and March and the other in December.

Compared with the seasonal distribution of bronchitis, influenza has been less evenly distributed through the year in the army; the periods of prevalence have been shorter and sharper and at the times of quiescence the disease has more nearly disappeared. The month of maximum prevalence has often been the same for bronchitis and influenza. In those years in which influenza has been exceptionally prevalent, bronchitis has often been unusually prevalent also. From the studies which have been made, it seems safe to infer that the word "influenza," has been used only as the name of a group of the minor respiratory infections which are prevalent everywhere in the winter months.

With reference to pneumonia, there has until recently been so little pneumonia in the army that the monthly distribution of cases does not appear to be significant. Pneumonia has been almost uniformly present throughout the year, the curve reaching its low-lying summit between January and March and its greatest depression in midsummer.

Turning now to the records of the United States Census Bureau for the forty-seven largest cities of the United States for the seven years 1910-1916, we find the same general seasonal prevalence existed in influenza, bronchitis, and pneumonia. We must here shift our attention from cases of disease to deaths, since the Census

Bureau only deals with the death records. This somewhat alters the situation, inasmuch as there are relatively few deaths ascribed to influenza and bronchitis and an excessive number to pneumonia in all such statistics. Furthermore, in vital statistics collected from civil communities, the age distribution of the population from which the data are derived is different from that in the army. The death rate from bronchitis is particularly high among children and pneumonia is essentially a disease of old age. One would expect, therefore, to find a good deal more pneumonia in civil life than in the army. Fortunately, the characteristics mentioned do not effect the relative seasonal prevalence.

Influenza, bronchitis, and pneumonia have all been essentially winter diseases in the cities and they have shown a tendency to drag along into spring. January has almost invariably been the month of greatest prevalence for influenza. In more than half the cities influenza has been practically absent between May and November. A few cities have shown an extended prevalence between April and October.

Bronchitis has been so uniformly present all the year through in the cities that it is easier to state when it has been least common than to name the months of its greatest prevalence. Generally, its seasonal distribution has corresponded with that of influenza except that its occurrence has been more continued and less irregular in a few cities where there have been long and severe seasons of it.

Pneumonia has shown less monthly variation than influenza or bronchitis in the cities, but it is essentially a disease of the colder half of the year. According to the statistics available, the month of greatest prevalence has always been December and March.

How are we to interpret the death rates from influenza and bronchitis reported by the cities? Did the people really die of the disease named? Probably not. According to the International List of Causes of Death, pneumonia should have been given as the cause of death in all or nearly all instances. The differences in the death rates from influenza and bronchitis which occur in different cities are probably ascribable to differences in the local custom of naming the disease. What is called influenza in one place may be termed bronchitis in another. It is probable that the high death rate from influenza at New Orleans and the excessive rate from bronchitis at Fall River mean that those cities had a good

deal of sickness which terminated in fatal pneumonia. It is certain that in ordinary times influenza, bronchitis, and pneumonia are frequently confused both in diagnosis and in the custom of reporting.

Probably there is a difference in the leading symptoms which accounts for the preponderance of reports in favor of influenza in some places and of bronchitis in others. Thus, bronchitis may be named in cities where the bronchial and laryngeal symptoms are prominent and frequent, and influenza is given where the nasal symptoms and sinuses are particularly involved. It is reasonable to suppose that there should be a difference in the leading symptoms where the predominating occupations and races are so different as they are among the cities of the United States. Manufacturing towns seem to have an excessive amount of bronchitis, a fact which may likely be due to conditions connected with the industries. Where southern towns have high influenza and bronchitis death rates the excessive mortality is generally ascribed to a predisposition on the part of the negro race to those diseases.

The healthiest cities, so far as bronchitis, influenza, and pneumonia are concerned, are those of the West and Northwest, where neither manufacturing, race, or age contribute to elevate the death rate from respiratory affections. Seattle, Spokane, Portland, Minneapolis, and Oakland have all low rates from these diseases.

Summarizing what has been said here with regard to statistics there is some chance that influenza has been occasionally or continually present in relatively mild form; that it has occasionally swept here and there in more or less broad but mild epidemics; and that it has recently increased greatly in severity.

The weight of evidence of all kinds indicates that the influenza which was pandemic is a highly virulent form of a disease which is commonly with us.

Clinical Department.

CASE REPORT: TRANSPOSITION OF VISCERA, TERTIARY SYPHILIS.

BY C. GUY LANE, M.D., BOSTON.

C. J. M., 27 years old, white, single, cook in the U. S. Fire & Guard, was referred to the dermatological ward of the Embarkation Hospital, Newport News, Va., because of an ulcer

on the outer surface of the left lower leg, and an eruption on the face and scalp. In the course of the examination it was noted that there was a visible impulse in the fifth right interspace inside the nipple line. With the stethoscope the point of maximum intensity of the heart sounds was found to be coincident with this impulse, and the heart sounds were found to be normal in rate and rhythm, regular and clear cut, without murmurs. Percussion indicated the right border of dullness to be 2 cm. inside the right nipple line at this place, the upper border at the fourth rib, and the left border at the midsternal line. On the left side of the chest in front, resonance extended to the fifth rib, and in the back both sides were resonant throughout. The lungs showed clear vesicular breathing everywhere with no râles.

Inspection of the skin demonstrated the fact that there were several different types of lesions present. On the face, neck and ears were several discrete, rather large, rounded papules, brown-red in color, some of them with gray scales adherent. Near the hair margin on the back of the scalp were three lesions, distinctly annular in arrangement, and made up of small, crusted papules with the hair matted to them. On the outer aspect of the left lower leg, near the malleolus, was a circular, punched-out ulcer, about 2 cm. in diameter, rather shallow, with a sluggish granulating base and surrounded by an area of redness about 1 cm. wide. These manifestations warranted a diagnosis of late or tertiary syphilis, and from the findings in the chest a tentative diagnosis of dextrocardia was made until confirmation could be obtained from x-ray examination.

The following day a fluoroscopic examination showed a pulsating shadow, corresponding in size to the normal heart shadow, on the right side of the chest. It showed the diaphragm moving evenly on both sides, and slightly higher on the left. Both chests were clear and showed no signs of fluid, masses, or adhesions to distort the position of the heart. Stereoscopic plates of the chest taken at this time and examined later confirmed the above findings. A barium meal was given and immediate pictures showed the stomach shadow located on the right side of the abdomen, and a picture taken at the time of giving a barium enema showed the tube pointing upwards on the right side, and the shadow of the barium