SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 16, 1906.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION K—PHYSIOLOGY AND EXPERIMENTAL MEDICINE.

SYMPOSIUM ON YELLOW FEVER AND OTHER INSECT-BORNE DISEASES. II.

Without Mosquitoes there can be no Yellow Fever: JAMES CARROLL.

It seems incredible, but is, nevertheless true, that at the present time there are still in the United States many physicians who oppose the idea that the mosquito is the sole means by which yellow fever is carried from one person to another. They refuse to believe that the natural disease can not be contracted in any other way than through the bite of the mosquito. The fact, however, has been repeatedly demonstrated and the evidence in its support has now become overwhelming. The tremendous importance of this subject, in a city which, by reason of her location and commercial intercourse with Central and South America, may be regarded as the gateway through which a disastrous epidemic may at any time be introduced into the United States, is my apology for again taking up so trite a subject. It is the duty of those who are familiar with the facts to communicate them to the members of the profession, for the people must rely upon their

physicians in all matters pertaining to the preservation of health and the prevention of disease. We can not expect that the active practising physician shall keep abreast of all modern advances in scientific medicine, and the numerous contradictory statements that have been made in regard to yellow fever have afforded full justification for skepticism on the part of such as aim to be conservative. While strong conservatism is to be commended, persistent skepticism is to be condemned. It is perfectly justifiable to refuse to receive statements that revolutionize our accepted ideas, so long as they are based upon the assertions of a single observer or a single set of observers, but when these observations have been confirmed by competent unbiased persons in different parts of the world, such statements must then be accepted as facts, just as we accept other statements in regard to history, geography and the sciences in general.

It is well known that a number of disease-producing animal parasites are never found in nature outside the body of a living host. They pass their whole existence first in one animal and then in another, alternately, being carried to and fro by means of biting insects, by the ingestion of infested food, etc. It is only necessary to consider here the group of parasites that is transmitted by the blood-sucking insects, such as the tick and the mosquito, the latter in particular. We know that the Texas fever of cattle is caused by an exceedingly minute microscopic parasite which spends its whole existence in bovines and in the tick. If cattle are kept free from ticks they can not contract the fever. Furthermore, the tick is now accused, and with good reason, of being the transmitter of relapsing fever. It is equally well known and proved beyond question that the mosquito transmits filarial infection and malarial fever to man. No one would think of asserting in print to-day that malaria is contracted through exposure to night air, to unhygienic surroundings or by drinking the filthiest water, for such statements would justly be characterized as absurd. The renowned experiments of Sambon and Low in Italy, in 1900, showed conclusively that persons can live in the most pestiferous malarial regions and retain perfect health, so long as they protect themselves against the bites of mosquitoes. In the same year these observers shipped living malaria-infected mosquitoes from Italy to England, where they were applied to two persons in perfect health in a region where malarial fever is unknown. Within a short time both of them suffered typical attacks of malaria, during which the parasites were frequently demonstrated in their blood. Fortunately the various stages in the development of the malarial parasite in man and in the mosquito can be demonstrated with the microscope. We know that the phases it passes through in the insect are entirely different from its cycle of development in man, and no one has as yet succeeded in demonstrating the existence of this parasite elsewhere than in a living host. Such a demonstration is not necessary, for with our present knowledge we can explain all the known facts relating to the contraction and dissemination of the disease and we can insure absolute protection against it. We no longer attribute malarial infection to the inhalation of gaseous poisons emanating from swamps in the nighttime, or to bad water. We know that swampy places simply furnish breeding grounds for the malaria-carrying mosquito, which flies at night, and whose bite is necessary for the contraction of the fever. The insect must previously have bitten a person suffering with malaria, and an interval of at least a week must have elapsed, otherwise no infection can result. The recent brilliant discovery by Koch,

that apparently healthy negro children in the pestilential districts of Africa constantly carry large numbers of malarial parasites in their blood, explains the source from which the mosquitoes obtain these parasites; it also explains the relative immunity against this infection enjoyed by the negro.

If we now consider the numerous points of similarity between malaria and yellow fever they will be found to be very striking. Both are diseases of low-lying districts; both infections are contracted chiefly at night; both may be conveyed by direct inoculation of the blood of a patient; both are most prevalent in the places and seasons where and when mosquitoes are most numerous; both infections are impossible after severe frosts, which cause the mosquitoes to hibernate. These constitute strong points of resemblance between the two diseases, which differ from each other in that the duration of yellow fever is very short, while malarial infection may persist for years. Unfortunately, the parasite of yellow fever has never been found, in spite of claims to the contrary, and notwithstanding the use of the best powers of the microscope, and even the ultramicroscope, in the efforts of skilled observers to discover it. That there is a yellow-fever parasite we feel assured, because it is not possible to explain the continuous propagation of the disease upon any other hypothesis, and apart from its invisibility, the manifestations of its presence are in complete accord with the behavior of parasites that are well known. We must not forget that the minimal limits of creation in nature may be beyond our conception, and we must be prepared to learn, if necessary, that there are living bodies too minute to be defined with our present instruments.

The report of the latest scientific investigation of this disease by Otto and Neumann, of Hamburg,[1] members of the German commission, working in Rio de Janeiro within the past year, states that they were totally unable to find anything either in the blood or in the cerebro-spinal fluid of patients suffering with yellow fever, that could not be found in similar material obtained from persons suffering with other diseases and from persons in good health. In this work they used the ultramicroscope of Siedentopf and Zsigmondy. Neither could they find anything in the infected mosquito after dissecting it in the fresh state, nor after hardening and sectioning it, that they felt justified in regarding as the cause of the disease.

How then are we to explain this failure to discover a parasite in an apparently parasitic disease? And, if a parasite be present, to what class does it belong? It seems quite rational to exclude it from among the bacteria because: (1) It has never been cultivated nor stained by any of our known methods; (2) the work of Marchoux, Salimbeni and Simond has shown that the blood of a patient after its withdrawal loses its power to infect within two days, if kept exposed to the air, and within five days if air be excluded; (3) the disease has been shown to be absolutely non-contagious in regions where *Stegomyia fasciata* is not present, *i. e.*, in Petropolis near Rio de Janeiro; (4) we know no bacteria that live in the tissues of animals, as the yellow-fever organism does in the mosquito, for months, as a harmless parasite. The logical conclusion, therefore, would seem to be that the parasite of yellow fever belongs to the animal kingdom, because: (1) It is absolutely necessary for its continued existence that it pass alternately through man and the mosquito, and its parasitic existence in these hosts is obligatory; (2) the fact that a period of about two weeks or more

[1] M. Otto and R. O. Neumann, *Zeitschrift f. Hygiene u. Infectionskrankheiten*, LI., 3, November, 1905.

must elapse before the contaminated mosquito is capable of infecting, points to a definite cycle of development in that insect; (3) the limitation of its developmental cycle to mosquitoes of a single genus, and to a single vertebrate, conforms to a natural zoological law and does not agree with our present knowledge of the life history of bacteria; (4) the effects of climate and temperature upon *Stegomyia,* and upon the rate of development of the yellow-fever parasite within the body of that insect, are exactly the same as the effects of the same conditions upon the *Anopheles* mosquito and the malarial parasite.

Consequently, although on account of its minute size no one has ever been able to identify the organism of yellow fever either in human blood or tissues, or in the mosquito, we feel justified in regarding it as an obligate animal parasite. If this be correct it can not maintain its vitality in water, in soil nor in any other material, no matter how badly they may chance to have been contaminated. Experience and experiments have shown that such is actually the case; that dead bodies can be freely handled and dissected by non-immunes without danger; that non-immune persons may live in intimate contact with the garments, bedding and clothing used and soiled by yellow-fever patients, under the same conditions and in the same climate where yellow fever has prevailed, and suffer no inconvenience. And further, it has been shown by the French commission that this organism fails to survive in blood, a most excellent culture medium, after it has been kept for forty-eight hours under ordinary conditions. This undoubtedly proves the inability of the organism to maintain its vitality in filth or decomposing organic matter.

Yellow fever is non-contagious, for in our medical literature numerous instances are recorded where numbers of patients were brought to certain places for treatment and no secondary cases resulted. This was before the days of disinfection, before any precautions were taken against mosquitoes, and at a time when intercourse with the sick was free and unrestricted. These strange occurrences were observed in Spain during a severe epidemic at Barcelona in 1821, during which, under the supposition that the air of the city was infected, there was a general exodus to the country. Here hundreds came down with the disease and were treated, but not a single case was recorded to have appeared in a person who had not visited the city. Yet tons of furniture and baggage were carried from infected houses into the country. All this took place in a warm climate and during the ravages of a devastating epidemic. Such remarkable occurrences were inexplicable mysteries that puzzled the most brilliant medical minds of the day; they could only be explained upon the theory that the air of the city had become contaminated. And so it had, but not with poisonous gases and noxious vapors as they supposed, but with infected mosquitoes. In the light of the mosquito theory the explanation is clear. An epidemic prevailed in Havana during the early part of that season, and a number of cases appeared on vessels after leaving there for the Spanish port, where the epidemic appeared later in the season. The first cases in Barcelona were seen on the vessels from Havana, lying in the harbor; then persons living in the city, but who had visited or were employed on the vessels, were taken sick; and later, the epidemic raged throughout various parts of the city. It is quite evident that the vessels carried infected mosquitoes as well as others that were not infected; these mosquitoes bred rapidly in the houses on shore and the conditions then became

ripe for a rapid extension of the disease after the introduction of a few cases. It is to be noted that vessels were constantly arriving from Havana; cases appeared on the ships during the voyage, and, until suspicion was aroused, patients from the vessels were treated on shore. The *Stegomyiæ* introduced from the vessels, being house mosquitoes, remained in the city, while the country districts were free from them, and for that reason free from any extension of the fever. The absence of the proper mosquito is the only explanation that can be offered, and in the light of our present knowledge, it is all-sufficient.

In the United States, both before and since the epidemic at Barcelona, there have been similar outbreaks, always introduced by importation, though frequently regarded as of endemic origin, *i. e.*, at Philadelphia, Baltimore, Norfolk and New Orleans. In the latter city the danger is particularly great, because *Stegomyia*, being always present, will readily spread the infection if it encounter a sufficient number of non-immunes.

Another good case in point is Petropolis, twenty-five miles from Rio de Janeiro and at an elevation of 3,000 feet. Yellow fever is never known to occur there, spontaneously, and for that reason it has been made the home of non-immunes who spend the night at Petropolis and visit Rio during the day, for the transaction of business. While there are no *Stegomyiæ* at Petropolis, the French commission showed three years ago that the disease can be produced there by inoculation with infected insects. At the present day one who seeks can find abundant evidence to show not only that the mosquito transmits yellow fever, but that without the agency of the mosquito it is impossible to have yellow fever, except by means of experimental inoculations.

Since the first demonstration of the mosquito theory by the army board in 1900, confirmatory experiments have been made by Dr. John Guiteras of Havana, Ribas and Lutz of Brazil, the French commission from the Pasteur Institute, Working Parties No. 1 and No. 2 of the U. S. Public Health and Marine Hospital Service; and lastly the German commission from Hamburg, admit no other possibility. The latter, whose report was published only two months ago, lay great stress upon the necessity for the extermination of mosquitoes in localities where yellow fever appears in epidemic form, because, they say, without the mosquito, extension of the disease is impossible. They advocate complete extermination of the insect, and speak with enthusiasm of the success that has been attained in Rio, in spite of the opposition of a number of local physicians and of a rather large proportion of the population. As a result of their observations in Rio, they maintain positively that the natural form of yellow fever can be contracted only through the bite of an infected mosquito of the genus *Stegomyia;* they are so firmly convinced of this fact that they decline to consider the possibility of any other mode of infection, since they could find no evidence in support of it. They found the yellow-fever mosquito everywhere in the city of Rio, but in Petropolis, where the French commission before them could not find it and where yellow fever is known never to spread, they failed to discover a single specimen. If one could say the same of New Orleans another outbreak of yellow fever there would be an impossibility, except when the mosquito as well as cases had been introduced. According to Otto and Neumann,[2] the authorities in Rio are about to adopt the admirable system of providing a mosquito-proof barrack for laborers in the harbor and docks, and they will keep the men

[2] The German commission.

under medical supervision, in order that any cases occurring among them may be protected at once from mosquitoes. This will insure that no secondary cases shall be produced by infection from them. They urge the necessity for protecting patients from mosquitoes during the first three or four days of the fever, because it is only during this period that the mosquito can acquire the infection. They state emphatically that in combating an epidemic all preventive measures should be directed against this insect and its relation to the patient. After proper protection of the patient all suspected mosquitoes must be destroyed, and efforts should then be made to exterminate all *Stegomyiæ* present in the locality, if possible.

Under the efficient management of the director of public health, Dr. Oswaldo Cruz, who is himself an experienced scientist, over $65,000 per month was expended in Rio de Janeiro, from April to December, 1903, in the war against mosquitoes. Even the main sewers were fumigated and myriads of mosquitoes destroyed in them by the use of sulphurous acid. A sanitary brigade was organized into sections for operation in the different districts into which the city was divided. The personnel of this brigade comprised about 2,000 men, including 80 physicians. Their duties were specifically defined as:

(1) The isolation of yellow-fever patients and their protection from mosquitoes, including the necessary arrangement of the isolation rooms; (2) the destruction of mosquitoes in the house and its surroundings and the destruction also of their breeding places; (3) the removal of the patient in a screened conveyance from his home to the hospital, if he desired it, or if it were impossible to isolate him in the house and the public interest demanded it.

All suspicious cases were treated as though they were cases of yellow fever and half-way measures were not tolerated.

A manifesto setting forth the relation of the mosquito to the disease and the necessity for the measures instituted was published on April 26, 1903, for the instruction of the people, and I can not do better than cite a few extracts from it to show the positive conviction of those in authority, who had already witnessed the confirmatory experimental work of the French and Brazilian commissions.

EXTRACTS FROM THE MANIFESTO.[3]

* * * * * * * * *

2. Yellow fever is not conveyed from person to person, nor is it transmitted by means of soil, or articles used during illness, the sole means of transmission is by the mosquito, as has been fully determined.

3. Several days after biting a case of yellow fever the mosquito acquires the power to transmit the disease, and it preserves that power for some time, two and one half months or more. The domestic habits of the mosquito explain sufficiently why yellow fever is a disease that establishes itself in houses and why it is contracted only in cities.

* * * * * * * * *

8. During epidemics, when the disease is at hand, all healthy persons should have mosquito nets upon their beds at night, and they should take care not to be bitten by mosquitoes during the day, because yellow fever mosquitoes bite also in the daytime.

The new harbor regulations for vessels entering with yellow fever on board are in part as follows:[4]

* * * * * * * * *

(*a*) The sick are immediately removed and isolated with mosquito netting.

(*b*) The mosquitoes in the entire vessel are killed systematically and their breeding places are destroyed.

(*c*) Passengers who intend to stay in the harbor receive a health certificate and are subjected to medical supervision for twelve days.[5]

[3] J. Dupuy, 'Epidemiologie de la Fievre Jaune,' *Revue d'Hygiene et de Pol. San.*, Paris, 1905, XXVIII., 13–29.

[4] Otto and Neumann.

[5] This is based on the prolonged periods of incubation reported by Marchoux, Salimbeni and Simond, and is unnecessary, because it has never been shown conclusively that an incubation period

(*d*) The vessel is then admitted to free intercourse, but admits a health inspector on board, who will accompany the vessel to its last Brazilian port and who proceeds as follows: (1) He examines daily, with care, all the passengers and the crew, and isolates with netting any who show symptoms of fever. (2) If mosquitoes be present their immediate destruction is ordered at once.

* * * * * * * * *

I have cited only a few paragraphs to show that the authorities have thoroughly grasped the situation and their ultimate success is assured. The gigantic nature of their undertaking in an unsanitary subtropical city of more than a million inhabitants can hardly be conceived, and their enlightened and determined efforts are exciting the admiration of the scientific world. With continued perseverance they will eventually attain the same degree of success that has been achieved in Cuba and their example will be followed by the smaller Central American republics.

After four years of immunity Cuba has been caught napping. According to the last report of the U. S. Public Health and Marine Hospital Service[6] she has had seventy cases of yellow fever, with fifteen deaths, between October 16 and December 17. Two of the cases were imported. According to the newspapers six additional cases have been reported up to December 25. While the condition is serious, there is no epidemic and the authorities have the situation under control. The large number of cases relative to the deaths reported shows that but few, if any, cases escape detection. I feel sure that the disease will be eradicated within the next two months. One or two or a few cases may appear in the early spring because some of the infected mosquitoes may escape fumigation and survive through the short winter. There is no reason to apprehend, however, that Havana will again become seriously infected.

Although I am now two years beyond the half-century mark, I think I can reasonably expect to live to see the day when yellow fever shall have been exterminated from the whole American continent, and that means practically from the world. Let us hope that the beautiful city of New Orleans will never again be devastated by the American plague from which she has suffered so terribly and so often. The price of safety is eternal vigilance; the greatest danger from yellow fever lies in the escape of mild and doubtful cases. One of the first to apprehend the full import of the mosquito theory was Dr. Quitman Kohnke, and I can recall with what pleasure I listened in Washington, several years ago, to his able, courageous and masterful contention for it, before a rather unsympathetic audience.

In the sad experience here during the past summer, we have seen an effectual demonstration by the various officials under Doctor White of the efficacy of measures directed against the mosquito. With this and the evidence already brought forward by Guiteras and the French, German and Marine Hospital Service commissions, it should never again be necessary to contend for the well-proved fact that without the agency of mosquitoes there can be no yellow fever.

Æstivo-autumnal Fever—Cause, Diagnosis, Treatment and Destruction of Mosquitoes which spread the Disease: H. A. VEAZIE.

This fever interests the whole world, es-

of more than six days and a few hours can follow a simple mosquito inoculation. In every instance in which a longer period of incubation is proved the subject received injections of either serum or blood. These observations therefore can have no practical bearing on measures directed against the natural infection which is produced by the mosquito alone.

[6] Public Health Reports, Washington, December 22, 1905, p. 2,739.

pecially Texas, Louisiana, Mississippi, Alabama, Florida, and New Orleans in particular, as it has been and will be mistaken for yellow fever. I only hope that this second paper on this fever may at least save a few lives, and call the attention of physicians to its proper recognition, treatment and prophylaxis.

Synonyms: 'Summer-autumn fever,' 'pernicious malarial fever,' 'congestive malarial fever,' 'hemorrhagic malarial fever,' 'up-river yellow fever.'

Geographical Distribution.—This is a fever that prevails in nearly all parts of the world where the *Anopheles* mosquito is found, influenced to a greater or less extent by climate; a pseudo-epidemic fever that prevails in tropical countries the year round. In semi-tropical and temperate climates it prevails from about July 1 to frost. In some years it prevails as an epidemic in tropical and semi-tropical countries, this being due to conditions favorable to the *Anopheles* mosquito. The conditions favorable to mosquitoes are frequent, light rains, and a temperature of about 70° to 90° F. I am quite certain a lower temperature is not incompatible with its spread, as I have found in this city *Anopheles* quite active at a lower temperature, but frost seems to cause the hibernation of nearly all of our mosquitoes. Extremely dry hot weather is unfavorable to the breeding of mosquitoes of all kinds; hence there is not as much malarial fever in the heat of summer.

History.—The history of malarial fever dates back from the time almost beyond history. The physicians of Egypt in the time of the Pharoahs wrote of it. In some of my past reading, and I am sorry to say that I have forgotten where I noticed it, I read that a physician of Egypt, whose name was Mah, stated that malaria was a disease produced by a parasite in the blood, but the organism was so small that the human eye was unable to see it. It was due to the labors of the immortal Laveran, a French army surgeon stationed at Constantine, Algeria, that the malarial parasite was identified and proven to be the cause of malaria (in 1880). Mechel in 1847 also described them, the ovoid bodies and pigment. Our own Professor Joseph Jones also did the same a few years later, he using the pigment as a means of diagnosis. He also shows quite a good rough sketch of malaria parasite in his 'Medical Surgical Memoirs.' It would be impossible for me to even read the names of men identified with the history of malarial fever. I must, however, mention Welch, Grasin, Councilman, Thayer, Manson, Young, Ross, Warner, Bastanelli, Golgi, Marchiafava, Celli and many, many others who labored hard and long to solve the malarial problem.

Etiology.—The cause of æstivo-autumnal fever is a parasite, a living micro-organism, a protozoon in the blood which enters the red blood corpuscles and destroys them, and in time is destroyed by the white blood corpuscles if the patient lives; otherwise, the destruction of the red blood corpuscles and toxins formed by the parasite kills the patient if proper remedies are not used, or if the white blood corpuscles are not sufficiently strong to overpower the parasites. Such cases are spontaneous cures. This parasite of æstivo-autumnal fever was studied extensively by Welch, and named by him the *Hœmatozoon falciparum.* I do not think that any one has yet completely settled its entire life history, as it seems most eccentric in its cycle of existence. A study of this alone would take years of patient work. However, the parasite is now well known and can be easily identified by proper staining, also in the fresh blood. A peculiarity of this parasite is that it seems to like to abide in the internal organs such as the liver, spleen, kidneys, bone marrow and

even the brain; hence, many of the cerebral symptoms. This parasite is the third form of malarial parasites. There may be a fourth form which causes what we now call yellow fever, and like many other diseases it may become obsolete as to name and possibly be classified as malarial. I have almost at times convinced myself that the two diseases were one and the same, but for the following reasons: in yellow fever there is no change in the number of red blood corpuscles; whereas, in malaria there is great change. In malaria the fibrin seems all right as to coagulative properties; in yellow fever the fibrin of the blood loses that important characteristic.

To get back to the æstivo-autumnal parasite: What does it look like? Where and how does it develop? Where does it come from? How did it get into the blood? With a one-twelfth oil immersion lens, the best working objective for blood work, we see in a red corpuscle in the first stage a very small ring-like refractive body which gradually gets larger and larger until the pigment is formed and the corpuscle is somewhat shunken or crenated. The pigment increases preceding segmentation of the parasite and the formation of crescents and also before the escape of the parasite from the red blood cells and the throwing off of the flagella. The flagellæ enter other blood corpuscles and repeat the cycle of development, unless destroyed by the white blood corpuscles or by some anti-toxin or anti-malarial drug such as quinine or arsenic in the blood serum. Where this parasite comes from is hard to say. How, when or where the first case originated is still one of the mysteries of nature. How does the parasite get into the blood? This is now well understood. It is through the agency of the *Anopheles* mosquito, and in all probability the *Anopheles crucians,* as the prevalence of this fever corresponds quite well with the flight and distribution of that mosquito. I would not consider this the only host for this parasite. Let us consider all mosquitoes as guilty, and destroy them at least for sanitary purposes. It is well known now that the mosquito bites an infected individual and the infected blood is taken into the stomach of the mosquito, there the blood is digested and the micro-organisms after going through certain changes, which are quite well known, form spindle-shaped objects which perforate the stomach walls. These are the zygocytes which go through different changes and finally get into the salivary glands of the mosquito, and are injected into the tissues of man's body, then in going through other series of changes produce the malarial parasite which we see in the blood of persons suffering from malarial fever. The various changes which take place in these bodies is quite well known, and almost any text-book on medicine describes the whole process minutely.

Period of Incubation.—It is not definitely known for this fever.

Clinical History.—This disease is usually ushered in with a chill of greater or less severity. The fever rises rapidly to 102° F., and as high as 105° F., even higher in bad cases. The pulse varies in different individuals from 100 to 160 per minute, and varies in various stages of the disease and condition of the patient. I have seen it as low as 40 per minute. Nausea, violent headache, backache and pains in the limbs usher in the disease. The fever usually declines at the end of ten hours and gradually disappears, possibly to return, or perhaps cured by nature or medication. If the infection is great or the patient is not taken care of, the fever assumes a more continuous character and many cases go into a state of collapse after a few days; the pulse in this case is slow and the

temperature low (subnormal). There is jaundice, with hemorrhages, albuminuria, black vomit, uremia, and death occurs in a manner very closely resembling that caused by yellow fever. The clinical charts vary as to pulse, respirations and temperature. The face and chest are quite red, the eyes congested—little photophobia—pupils about normal for amount of light present. Ophthalmoscopic examination of the retina shows it somewhat congested, the optic disk slightly so. The lips are somewhat red, during chill quite blue. The gums are usually normal or slightly red, except in bad cases, when they are spongy and bleeding. The tongue is somewhat broad, with yellowish coating, sometimes indented. There is tenderness over the stomach, liver and spleen both somewhat enlarged. Jaundice is usually noticed after the first day. The urine is increased in quantity, then diminishes, and often contains bile, albumin, casts and blood. The blood taken from the lobe of the ear or from finger-tips shows æstivo-autumnal parasites. In the year 1899 this fever was investigated by Dr. J. D. Bloom, then surgeon of the Charity Hospital of this city; Dr. O. L. Pothier, pathologist and bacteriologist of the Charity Hospital; Dr. G. S. Bell, visiting physician of the Charity Hospital; Dr. S. Y. Mioton, assistant pathologist of the Charity Hospital; Dr. Maurice Couret, assistant pathologist of the Charity Hospital, and the speaker. In every case we found the æstivo-autumnal parasite where the blood was examined. This was done in over a hundred cases. The blood of one hundred and thirteen persons (not ill) was examined out of that number, and eleven had the parasites in their blood, and on tracing the history of the eleven six had the fever and five were afterwards taken ill. I will now detail one of Dr. G. S. Bell's cases simulating yellow fever with black vomit, ending in recovery, recorded by collaborators in the article published in the *New York Medical Journal,* May 19 and June 2 and 9, 1900, to which I would refer any one who wishes further cases, clinical charts, etc.

M. G. A boy sixteen years old, born in Bayou LaFouche, La., family history good; previous history good. Patient came to New Orleans two weeks before taking sick, but had been feeling bad for a while in LaFouche. Complains of pains throughout the body, chilly sensations, impaired appetite, tired feeling, etc. On October 18, he was taken sick with fever, headache, no appreciable chill (no chill), vomiting, pains all over the body. The same symptoms continued the next day, October 19, 1899. Dr. G. S. Bell was called for the first time to see the patient on October 20, 1899, and found the following conditions: The patient was very nervous, restless and suffering with intense headache; eyes slightly jaundiced; stasis, but not very marked; gums slightly soft. He had profuse diarrhœa. It was stated that the patient had twenty actions from the bowels; they were watery but of natural color. Temperature was 104° F., pulse 120, respiration 40. Dr. Bell making a careful physical examination found heart normal, lungs normal, liver slightly enlarged, spleen distinctly enlarged and tender on palpation. On examination of the blood he found malarial parasites, urine contained two per cent. of albumin, hyaline casts, bile, no granular casts. Ordered five grains of bisulphate of quinine in water every three hours. October 21 (fourth day of illness): Temperature 102.4° F., pulse 112, respiration 32. Other symptoms about the same, malarial parasites still present in the blood. Urine contains two per cent. of albumin, bile, hyaline casts. Ordered five grains of bisulphate of quinine; continued every three hours. No other treatment. October 22 (fifth day of illness): Temperature 101° F., pulse 112. Patient vomiting black. He had black vomit three times while Dr. Bell was at his bedside. The blood still contains a few malarial parasites. The stomach being irritable, Dr. Bell stopped the quinine by mouth, and gave him five grains of bisulphate of quinine hypodermically every three hours and stopped all nourishment. He saw the patient twelve hours after; stomach was less irritable, vomiting had ceased; patient feels better. October 23 (sixth day of illness): Patient feels much better, temperature 100° F., pulse 80, respiration

28. Stomach in good condition. The patient retained five grains of bisulphate of quinine every three hours, also retained small quantities of milk. Jaundice did not increase. October 24 (seventh day of illness): Patient still improving and feels much better; stomach in good condition, temperature 100° F., pulse 78, respiration 24. October 25 (eighth day of illness): Temperature normal, 98½° F., pulse 60, respiration 20. October 26 (ninth day of illness): Temperature 98½° F., pulse 48; respiration 20. October 27 (tenth day of illness): Temperature 98.4° F., pulse 48, respiration 18, urine normal. Patient went on to uninterrupted recovery.

Dr. Bell's cases total fifty-five in number, carefully observed microscopically, physically and every way possible.

Total number of cases seriously ill, fifty-five; total number of cases which were very ill but not in danger of death, twenty-one; total number of recoveries, fifty-four; total number of mild cases, fifteen; only one death—all treated with quinine. Of the fifty-five cases, fifty-three were natives of New Orleans and lived in New Orleans up to the time of illness. One was born in New Orleans, but lived in LaFouche ten years. Of the fifty-five cases forty-eight cases occurred in forty-eight different houses; the remaining seven occurred, as follows: Two cases in one house; two in another. No family visited by Dr. Bell consisted of less than five members; seven had had yellow fever.

Sex of Patients.—Males, thirty-five; females, twenty. *Race.*—White, 50; colored, 5. We all had many cases of this fever, but I quote Dr. Bell's, as all records were bedside records carefully taken.

Pathological Anatomy (gross).—Autopsy No. 900. Lungs: right, twenty-three ounces; left, twenty-three ounces. Spleen: nine ounces. Pancreas: two ounces. Heart: fourteen ounces. Liver: eighty-four ounces. Kidneys: right, six ounces and one quarter; left, six ounces and one half. Body of white man slightly jaundiced about face and neck, conjunctiva yellow; pupils slightly contracted; post-mortem rigidly marked; heart, normal; lungs, œdematous; spleen, soft, muddy, enlarged and intensely congested.

Liver.—Fatty degeneration marked.

Gall Bladder.—Full. Pancreas, normal. Kidneys congested; granular, slight fatty degeneration.

Diagnosis.—From post-mortem, Dr. O. L. Pothier, pathologist; acute pernicious malarial fever.

Microscopical Pathological Anatomy.—In acute or primary cases there is slight or no pigmentation of organs, but the organs mostly infected are found full of malarial parasites, especially the spleen, the liver, kidneys and brain. I fear if I go too far in minutiæ I shall tire you. In this æstivo-autumnal fever the patient is either dead or well before the usual evidences of malaria are produced. Hence, the finding of the crescent, or ovoid bodies in the various organs is the most reliable sign. Nearly every organ is in a state of congestion.

Diagnosis.—This disease in the first day or two can be confounded with almost any disease beginning with chill, fever and high temperature. If the patient lives in the country or suburbs the malady is likely malarial, as this fever usually occurs in the country or suburban districts. That is the case in this city; whereas, yellow fever usually starts in the older quarter, thickly populated districts near the wharves and shipping, and among newly arrived persons. The finding of the crescents or æstivo-autumnal parasites is proof positive that the patient has this fever beyond question. Whether it is a mixed infection or not is another question; it is possible but not probable. Sir John Hunter was right in a measure, but we do know that sometimes there occurs mixed infection—say, typhoid and yellow fever. At times malaria also complicates both of these diseases. Under these circumstances, the wisest and most astute physician may be puzzled. When you find the patient has the malarial parasite in the blood, he certainly has malaria, and very seldom anything else. The finding of the parasite is a certain indication of malarial infection. The test of Torti,

the giving of quinine, and if the patient recovers rapidly, show that it is simple uncomplicated malaria. If not, the test of Widal for typhoid and the Faget law for yellow fever until we find better means. The yellow fever parasite or materies morbi must be a parasite, but extremely small, and will be found in the fibrin or serum of the blood, or as a captive in the white blood corpuscles, as the red ones do not appear to suffer in numbers from yellow fever infection, but greatly so in all forms of malarial infection. So the diminution of red blood cells is a diagnostic factor and a very important one in malarial infection, and its absence in yellow fever helps us to separate the two diseases.

The presence of free pigment in the blood is also diagnostic of malarial fever, and was greatly relied upon by my honored and respected preceptor, Professor Joseph Jones, M.D., of the medical department of the University of Louisiana—now medical department of the Tulane University of Louisiana. I am in hopes that the organism recently found by my friends of the Charity Hospital and Emergency Hospital, of which very little has been written, will prove to be the cause. This organism is still *sub judice,* and I would prefer that they describe it, as to them is due the honor of discovery. I hope at last that the long-sought-for yellow-fever organism has been found. We must wait, however, for more proof—the greatest of honors to the man or men who find it, as it has long been sought. The malarial patient is more quiet, not as alert as the yellow-fever one. The eyes are not watery in malarial patients, though they may be red. The yellow-fever eye is pink rather than red and watery—'like a person who has been exposed to irritating smoke.' The malarial eye is not so bright. The yellow-fever eye actually shines in the first twenty-four or forty-eight hours, then may get dull. I think Faget's law is quite characteristic of yellow fever, but is not certain by any means, as charts of æstivo-autumnal fever do show the same want of correlation. A positive diagnosis can hardly be made of yellow fever to differentiate it from malarial fever, unless the malarial parasite is found; and Torti's test with quinine is positive, when we should conclude that the patient had malarial fever and not yellow fever. Still he might get well in spite of the quinine or other treatment, even if he had yellow fever, so it is best to treat sanitarily all cases of fever by screening, at least with a bar to protect them and others from mosquitoes, even if it is malarial. Bile, albumin and casts in the urine, so long thought characteristic of yellow fever, are often found in æstivo-autumnal fever. A point which was brought most forcibly forward by an old physician of this city was this: He said in years gone by they did not question the diagnosis of yellow fever, but when an epidemic of fever would break out, they would ask one another: Does quinine break the fever this year? I think that is quite significant as to the close resemblance of the two fevers when it comes to clinical evidence alone, and with the means at hand of the older physicians—no microscopical knowledge, no record of temperature. The only guides for them were those gained by inspection and taxis. The pulse, as we know, gives some help, but little, however, when these two diseases are to be diagnosticated one from the other. We have made but little advance, however, in our means of positive diagnosis. It is more positive as to malaria, and when the æstivo-autumnal parasite is found the cases are ninety-nine in one hundred malarial, and quinine will cure them. I could write pages of symptoms, such as peculiar facial expression of yellow-fever patients; the

tongue, odor, etc., but none are at all reliable.

Treatment.—In the alkaloids of Peruvian bark we have the specific quinine given in the form of the bisulphate or chlorid. The older form (sulphate) does not seem to kill so effectually or quickly this form of malarial parasite, because, for some reason, it is not absorbed; if so it may not have sufficient solubility to affect the parasite. I have been in consultation with physicians, and they have said that this disease can not be malarial, as I have given large doses of quinine, and the patient did not improve. They were giving the sulphate in capsules, and the patient did not absorb it. I give the bisulphate of quinine in capsules, and perforate each capsule at each end just before administering it. If you perforate the capsule some time before administering, the quinine sifts out and the patient gets the bitter taste. If the stomach is so irritable that the quinine is rejected, then give, per rectum or hypodermically, either the bisulphate or the chlorid dissolved in sterilized water. Fifteen or twenty grains daily are usually sufficient, except in malarial coma when I give more. I gave as much as one hundred and twenty grains of the sulphate by rectum, some years ago, when I did not know of the utility of the bisulphate. When giving the hypodermics insert the needle deep into the thigh or arm, and abscesses are not so liable to occur. Fifteen to twenty grains in twenty-four hours is effectual, continued until you can medicate by mouth. I usually give in the ordinary cases a simple purge, such as calomel and soda followed by a saline purge, or simply a seidlitz powder, citrate of magnesia, in fact any purge is efficient. Then push the quinine in doses of fifteen or twenty grains daily until the fever is gone. The patient must be kept in bed and under the influence of an antiperiodic for at least twenty-eight days, or the multiple of seven, as there are usually four generations of parasites to get rid of. The diet should be liquid during the febrile stage (soups, milk and broths); solids should be given gradually; plenty of water such as vichy and other alkaline drinks are desirable. Mortality of this fever is practically nothing, if properly treated and cared for. If not, then you have a most fearful condition of affairs, and you can imagine yellow fever or most anything else. What means should be instituted by communities to prevent this disease from spreading? Our esteemed friend and collaborator, Dr. J. H. White, makes the assertion that yellow fever can not be introduced into a community except by a sick person. It is the same with this fever. The mosquito in both instances must be infected from a person infected; otherwise, its sting is simply painful for a few minutes and conveys no disease. Consequently quarantine against freight is useless and harmful to all concerned. It is the sick person we must look out for; the infected person.

Sanitary measures necessary to prevent the spread of this disease are the same as those for yellow fever. Screen the patient, destroy all mosquitoes and their breeding places; have no mosquitoes and we will have no malaria or yellow fever in our midst. When making extensive improvements either in a city or country, observe this well, as it is very important from a sanitary standpoint. In these improvements the previously existing drainage natural in the country, artificial in cities, is usually interfered with and stagnant water accumulates and mosquitoes breed. Therefore, see that no still or stagnant water exists. The greatest friend we have is the little minnow, the top minnow or *Gambusia affinis*. This little creature abounds in nearly all southern states, and is one of the greatest enemies to the mosquito, so cherish

them and have them in ponds or undrainable accumulations of water. Screen your cisterns, or water tanks; salt your gutters, as was done by Dr. J. H. White, in this city last summer. Two and one half per cent. solution is sufficient, or oil them with kerosene as has been suggested and done by Dr. L. O. Howard. Both methods are extremely successful as I have seen in this city during the past summer. It was thought by our citizens that we could not get rid of mosquitoes, but it was certainly done by Dr. J. H. White and the citizens of this city. The past summer was the first summer that I can remember having slept without a mosquito bar, and many thousands in this city can say the same. The *Stegomyia colopus,* which is the correct name, as I am lately informed by Dr. L. O. Howard, was hard to find after the measures were adopted. I had hard work to find them for experimental work; before this summer I could go into any house, and get all I wanted. I tried in every way to see if I could get larvæ by the usual method of placing uncovered receptacles holding water, and for two months no larvæ appeared. I have not seen any stegomyia in my house since the screening and work done for their extermination. The anopheles mosquito, or malarial mosquito, breeds in the swamps or large ponds where there are no minnows or fish; so, drain, fill, stock them with numerous fish, salt or oil them.

The destruction of infected mosquitoes in homes, ships, etc., is best done by culicides. Sulphur kills them and other insects, but is so destructive to things such as furniture, delicate fabrics, etc., that people will not use it; pyrethrum is expensive and does not kill; it simply stupefies. Dr. J. H. White, knowing these difficulties, appointed a committee to investigate culicides. This committee was composed of the following members: Dr. J. H. White, president; Dr. Rupert Boyce, vice-president; Dr. Donald Currey, Dr. W. H. Perkins, purveyors; Dr. Q. Kohnke, Dr. H. A. Veazie, secretaries.

The committee, after trying various substances, tried the culicide of Mr. J. C. Mims, the analytical chemist of this city, and chemist to the city board of health. This culicide was first used by him to kill mosquitoes, after years of experimenting with various substances. He tried equal quantities of gum camphor and crystallized carbolic acid, and found that it was most effectual as a culicide, and I am quite certain it is a most excellent germicide, as it should be theoretically and as has been shown in some recent experiments. This culicide is made of equal quantities by weight of carbolic acid and gum camphor; the crystals of the carbolic acid being melted by gentle heat and poured over the camphor, and the clear liquid colored blue, by methylene blue, simply for safety's sake, and the liquid volatilized by heat. The vapors kill all insects, mosquitoes most effectually, and destroy or injure nothing whatsoever except animate things. This culicide and disinfectant was used most extensively last summer in the most elegant houses, Pullman cars and ships with the most satisfactory results. Every imaginable insect, such as mosquitoes, flies, roaches, etc., was killed by it, and nothing whatsoever, except living things, injured. The expense of this culicide is between that of sulphur and pyrethrum. It is far better than either. It is safe when properly used, and kills insects from the top of the room to the floor, when used in proper quantities, three ounces to the thousand cubic feet. All broken panes of glass must be covered and pasted, ventilations closed, and fireplaces of room closed up so that none of the vapor escapes. The only trouble was that connected with generators, which had to be effectual and safe, as the

liquid is somewhat inflammable but not explosive.

I have constructed a generator which answers all purposes and is safe. I am in hopes of having them made in quantities, so that if necessary, this culicide can be used extensively. It is absolutely certain that this culicide and disinfectant injures nothing but living things—the most delicate fabrics, metals, etc. I would be pleased to give any information to any one as to its efficiency. For lack of time, I can not speak further of this most wonderful agent.

I thank you all for your kind attention.

WILLIAM J. GIES,
Secretary.

SECTION B—PHYSICS.

THE annual meeting of Section B, Physics, of the American Association for the Advancement of Science, was held in the Physical Laboratory of Tulane University, in New Orleans, on December 29 and 30, 1905, and on January 1, 1906. The presiding officer was the vice-president of Section B, Professor Henry Crew, of Northwestern University. The other officers in attendance were the retiring vice-president, W. F. Magie; the secretary, D. C. Miller; member of the council (no election); member of the general committee, H. T. Eddy; members of the sectional committee, Henry Crew, W. F. Magie, D. C. Miller, A. Trowbridge (elected at this meeting to serve for five years), E. L. Nichols and F. E. Nipher; press secretary, J. R. Benton.

It was decided by the general committee that the next annual meeting would be held in New York City in convocation week, 1906–7; and that those sections desiring to do so might hold a summer meeting in Ithaca in the latter part of June. The desirability of such a meeting for Section B will be determined by letter ballot. The presiding officer for these meetings will be the vice-president elect, Professor W. C. Sabine, of Harvard University. The other officers for these meetings, so far as now determined, are:

Retiring Vice-President—Henry Crew.

Members of the Sectional Committee—W. C. Sabine, Henry Crew, D. C. Miller, A. G. Webster, G. F. Hull, F. E. Nipher, E. L. Nichols, A. Trowbridge.

Secretary—Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

On December 31 the retiring vice-president, Professor W. F. Magie, of Princeton University, gave a most interesting address on 'The Partition of Energy'; this address was printed in full in SCIENCE for February 2, 1906.

Because of mutual interest in the papers offered in Sections B and D, and because the programs were short, two joint sessions of these sections were held. The program of papers presented is given below, with abstracts of all but one of those belonging to Section B; the abstracts of the other papers will be given in the report of the secretary of Section D. There was ample time for full discussion of the papers, and advantage was taken of this opportunity, adding much to the enjoyment of those attending.

Although the attendance was small (there were about thirty-five present at each meeting), yet the quality of the meetings in every respect was quite up to the average, and all were unanimous in expressing the opinion that the sessions had been both profitable and enjoyable. Excursions to the pumping and drainage stations, to a sugar plantation and mill and to a sugar refinery, as well as the miscellaneous attractions peculiar to New Orleans as a city, were greatly enjoyed by those in attendance.

An Experiment on Easterly Deviation Beneath the Earth's Surface: F. W. MACNAIR, Michigan College of Mines.