HERDS AND INDIVIDUALS.1


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The term "herd" as a prefix to denote properties of a community, or group, as distinct from similar properties of the individual members of the group, was first popularized by the psychologists with the phrase "herd-instinct." Topley, I believe, was the first to use the word to describe physiological and pathological qualities of the community. He coined the term "herd-immunity" to express the resistance of a population to the spread of epidemic disease in contradistinction to the sum of the individual resistances of the members of the group. In some quarters the term "herd" has been criticized as out of place when applied to human beings. However, since the time of Huxley, it has been realized that there are no significant anatomical differences between man and the higher primates, and recent studies, in human and other animal behaviour, indicate the mental differences are quantitative rather than qualitative. But, unfortunately, just about the time that the new Adam looked round his garden to re-name the animals in it, he was beginning to think he had found out most of Nature's secrets; also, since he had for centuries believed he was created in God's image, he felt justified in calling himself Homo sapiens. To-day, I think, the new Adam is more modest and would have been more likely to suggest ignoramus, or at least inquirer, as his specific designation, and left sapiens for a future product of evolution. Because, although it is absurd to pretend that man has found out nothing from the mass of facts and observations he has accumulated in recent years, yet he is getting a glimmering idea that, before he can expect an answer to many of the questions he is asking of Nature, higher intellects and better instruments, than any that are at present in use, will have to be evolved; as doubtless they will be in the distant future. For these reasons the term "herd" is a very appropriate prefix to describe the attributes of human beings considered collectively, instead of individually, because it emphasizes the biological truth that there is little fundamental difference between a herd of deer, a herd of swine, and a herd of Homo sapiens.

Every district or environment supports a community of animal and plant life consisting of many species. The species in the same area are adapted to different parts, niches, or corners of it. These habitats overlap

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1 Presidential Address to the Naval, Military and Royal Air Force Hygiene Group of the Society of Medical Officers of Health and reprinted by permission from Public Health, April, 1929.
and the species in them clash with each other to a greater or lesser extent, and in doing so interact on each other’s life histories. The study of the mutual relationship between living organisms and their environment is known as ecology. Preventive medicine is mainly applied ecology; since it is based on the study of the mutual relationships between man, other living organisms and the environments they occupy, and the way these relationships affect human health. All the factors which form the human environment are continually changing. For example, consider the weather, the amount and type of movement in the human herd, and the ever-changing character of the bacterial herds whose environment is man himself. Therefore, it is obvious, no species can exist without some mechanism by which it can adjust itself to the alterations which continually take place in its surroundings. The power and rapidity of adaptation to different environments vary enormously in different species of animals. This quality whereby a species as a whole, or as an individual, can vary in response to different environmental stimuli may be called plasticity. Men and microbes are very plastic groups, and are thus able to adapt themselves to a wide range of physical and biological conditions. The ubiquity of bacteria has rendered it essential that, in order for man, or any other animal, to survive as a species, he should be able to respond as easily to changes in the bacterial flora of his environment as, say, to changes of temperature. It is important to distinguish the adaptive variations in animals, which are impressed on them by the environment during their life-time, from the hereditary specific characters, which may also be adapted to fit a particular environment, but which have been imprinted on the germ plasm during the passage of the species through geological time. In this respect plasticity, or the quality of producing adaptive changes when the need arises for them, is an hereditary specific character, but the resulting adjustments themselves are acquired non-inheritable characters. For example, the potentiality of producing diphtheria antitoxin in the blood is an inherent specific character of human germ plasm and as such is present in all individuals; but this potentiality only becomes apparent when the human animal finds itself in contact with the diphtheria plant. Other individuals of the species in whose environment there are no diphtheria bacilli, though possessing this power of forming antitoxin, never do so, because there is no need for it. The potentiality of forming antitoxin may vary in degree and such variations are true hereditary differences; but the actual presence of diphtheria antitoxin in the blood is an acquired character, and not inherited. The mechanism by which highly-specialized animals attained their hereditary adaptive specific characters is too controversial a subject to touch on here, but it seems that a species which in the course of evolution has become, probably through competition with other species, very closely adapted to a special environment sacrifices its plasticity in the process. The young of such a species may be likened to rigid metal castings, which will only fit the one special environmental mould wherein their ancestors were cast;
while the young of a plastic species are like lumps of soft wax which slowly take the impression of any surface they happen to lie on. A rigid species may have become so specialized to one form of existence, by the evolution of elaborate organs and apparatus, that it becomes unable to fit any other. Such a closeness of adaptation is a great advantage as long as the environment remains constant. But should the surroundings alter, the highly-specialized organism may find itself unable to fit the new conditions. In this way over-specialization may have accounted for the extinction of many of the species in the geological record. Over-specialization, however useful to the individual, is a grave danger to the species. It may be that this remark also applies to the medical herd! Man has fortunately remained a very primitive animal in general structure, and thus retained a large degree of plasticity. Perhaps a surgical analogy will make my meaning clearer. One can remove the top of a tonsil easier with a guillotine, which is closely adapted to this single environment, than with a scalpel; but if the environment changes from the tonsil to the leg, the guillotine becomes useless, while the scalpel can still do its job—it is the more plastic and less specialized instrument. Again, a man may not be able to exist on oats, or cross the prairie, as efficiently as the highly-specialized horse, but he can still climb a tree and live on nuts, while, as far as I know, the horse can do neither. The horse is a more specialized, but a less plastic and primitive animal than man. Man has also wonderful powers of adaptation to the various parasitic flora and fauna which inhabit his range of environments. Considering the extent of this range, and the rapidity and magnitude of the environmental changes man submits himself to, it can only be due to man's remarkable plasticity that there is relatively so little symptomatic parasitic infection in the world. When years ago I used to wander about Canton city, and travel up and down the Pearl River in one of His Majesty's gunboats, I marvelled, fresh from reading a textbook on hygiene, how the Cantonese managed to keep alive. There was no sanitation, no ventilation, and a density of population as great as that in any part of the world. The Pearl River itself is the main drain of a huge agricultural basin as well as the water supply of the thousand towns and villages on its banks. On the pea-soup waters of this river dwell myriads of families whose home is the junk or sampan they work on. Frequently the proprietor of one of these floating dwellings can be seen relieving nature over the bow, while his spouse collects the family drinking water over the stern. Although typhoid fever and intestinal diseases were common among sailors and other Europeans, yet as far as I could learn the Cantonese rarely suffered from clinical enteric fever. It might be argued that the escape was due to lack of contact with the parasitic causes of enteric fever, but Mendelson [1] gives some precise figures from Bankok, an environment not unsimilar to Canton. He states that among 35,000 Asiatics admitted to hospital he has not seen more than two or three patients with a clinical picture of typhoid fever, but that among 600 of the ordinary population, 98 (or 15·5 per cent) gave
positive Widal reactions, which means they must have been in contact even if not infected subclinically, with *B. typhosus*. I cannot see how we are to explain such observations as this, except on the theory of a special adjustment to the bacterial environment. The Asiatic baby is born with a passive immunity passed over to him from its mother by way of the placenta and milk. The mother's immunity has been acquired by continual doses of subinfections with the intestinal organisms which must contaminate almost everything she eats and drinks. In the native races of the East, it would almost seem as if there can only be two alternatives for the infant—death from infection, or adaptation to the local intestinal pathogenic flora by the acquisition of an active immunity before the congenital passive immunity has completely faded. Herein, perhaps, lies one of the causes of the very high infant mortalities of the Asiatic peoples. The absence of enteric fever is therefore not due to the absence of the specific organism, but to mutual adjustment between it and its human environment. I have only given this one series of observations to illustrate the importance of studying human infections as part of the general problem of adaptation to the environment, since I feel convinced that it is only by approaching human infection from the ecological point of view, and looking on epidemics as manifestations of a loss of balance between the mutual adjustment of host and parasite, that the natural laws controlling the periodicity, extent and malignancy of diseases of herd or individual will finally be defined.

Important as this subject is, to-day I wish to dwell chiefly on another biological quality which also is an adaptable character. Just as one species has to adjust itself to other species whose habitat coincides with, or overlaps, its own, so do the members of those species who live in herds or communities have to adjust their behaviour to each other in order to fit the special conditions of a gregarious life.

During the struggle between species to avoid elimination, certain members of the same species evolved the quality of acting together as units for their mutual benefit. The character of co-operative action was obviously an advantage, since it became preserved in many species, including man. With the social community or herd, a new quality or modification of the sex instinct had to be evolved in order that the individual would act for the herd as well as for himself. This quality is generally known as herd instinct. Herd instinct is such a powerful force in all human behaviour that it makes normal psychology a more important subject than most of those who are responsible for medical education seem prepared to admit. Anyhow, it seems to me that medical men who are responsible for the health of herds ought to give more attention to group psychology than they do. Generally speaking, it is the custom before anyone professes a trade to learn how to use the appropriate tools. For instance, no histologist would imagine he could do good work unless he knew something about the mechanism of the microscope, and above all, the definite limitations
of this instrument. It seems very strange, therefore, that the one tool which every human being has to use in order to exist, namely the brain, or engine of the mind, is the only one of the limitations of which it is thought worth while to warn the users. I propose to spend a little time in considering the frailties of this complicated machine which is liable to all sorts of errors and breakdowns. The brain as a machine is exceptionally dangerous because it seldom gives its owner any indication of when there is a screw loose in its gear-box. My apology for venturing to talk about herd psychology, of which I have little knowledge, is that even if I say things that are absolutely incorrect, in doing so I shall be furnishing a practical example of the importance of proper instruction in the subject, because it is self-evident that a naval officer, especially a medical one, should know something about group psychology, on which depends morale, esprit de corps, élan, and that subtle difference between happy and unhappy ships as the Navy terms them. All of which are of paramount importance to the fighting efficiency and the health of the Services. Perchance a little knowledge of psychology might also be of more use to the ordinary public health administrator ashore than even a sound knowledge of lavatory fittings, if it enabled him to coax his district council into putting up an abattoir, or rebuilding a slum in his district when the public health interests demanded it. I think that anyone who tries to get behind the fact, fiction, sound sense, and meaningless verbiage that has been written round the subject, since Freud enunciated the theory of unconscious mental conflict between antagonistic instincts and complexes, must realize that man is the unconscious plaything of his own emotions all the time he fondly imagines that he is a reasonable animal. That this is possible is largely due to that most important mental process called "rationalization," by which we unconsciously repress all the evidence against anything we wish to believe, and exaggerate everything in favour of our own desires. It is as well the human mind has this faculty; without it, life would be unbearable to the individual and cooperation impossible for the herd. If anyone has not sufficient power of introspection to see himself as an irrational being, he will anyhow be able to agree the proposition is true of his friends or his wife. If we can become aware of the fact that our motives are not always what we imagine them to be, the fact itself becomes less dangerous. Every honest research worker must have experienced the sort of feeling of temptation to ignore a piece of evidence, or belittle the result of some experiment which does not fit in with a favourite hypothesis. What, however, most workers do not realize is that such temptations may be succumbed to without the worker himself even becoming aware of the fact that his work has been vitiated by his own unconscious bias. This unconscious repression of significant facts probably accounts for much conflicting evidence in medical research, and makes it wise to keep an open mind with regard to all new scientific discoveries, until they have been confirmed—preferably by an enemy of the originator.
Herds and Individuals

The above sources of error are caused by what may be termed endogenous suggestions, which arise out of the individual's own subconsciousness. Exogenous suggestion from a fellow-member of the herd may have an equally unrealized influence on the results of investigations or on the behaviour of herds and individuals. The following illustrations are from my own experience. At a time when I was examining the mechanical ventilation of one of H.M. cruisers, an officer complained that he was not getting a fair share of the air supply. I placed my hand over the air inlets in his cabin and mine, and agreed that there was less air coming into his cabin than into mine. But when an anemometer was substituted for the palm of the human hand, the instrument, being insusceptible to the power of suggestion, showed that air was entering the complainant's cabin at 22 miles an hour, which was at a rate three miles an hour more than in mine. Suggestion had made my hand an unreliable instrument for judging draughts. This illustrates why it is advisable to use instruments of precision in medical work, whenever possible, rather than trust to sense organs which are subject to all sorts of inhibitory and amplifying stimuli from the higher centres. Those honest but credulous individuals who are able by the aid of Abram's box to percuss out any area of dullness they subconsciously happen to think of, are another good example of the terrible limitations of sense organs when under the influence of suggestion. A more homely example of the power of exogenous suggestion has been seen by every naval officer who has had much experience of wine catering in the wardroom. If a self-opinionated but popular member of the mess declares "this wine is filth," three-quarters of the mess, being gregarious animals like sheep, will probably agree, and that wine is damned. The wise wine caterer says nothing. He merely removes the offending wine for a week or two and then replaces it without comment, with the almost invariable result that the reappearance passes unnoticed and the whole mess starts re-drinking "the filth" with gusto. This little anecdote introduces one of the greatest of the subconscious forces that sway us against our reason—the so-called herd instinct. I know that advanced Freidians say there is no such thing, and that what is called herd instinct is merely modified sex instinct, but for the non-elect herd instinct by another name would be just as real a force. Herd instinct is a biological necessity for gregarious animals such as man in order to get a group of individuals to act collectively. For example, imagine party government without it. If politicians, who I believe are as consciously honest as most herds, were really rational beings, how would it be possible for 600 members of Parliament to divide completely into the same two groups, each group completely convinced they were right on all sorts of subjects where, in most cases, the question to be answered is such that a definite "yes" or "no" is impossible. For example, take an issue like Free Trade. On such a subject the scientific attitude of a parliamentary candidate should be something like this: I regret that I have only studied the difficult
subject of political economy for twenty years, and I therefore do not feel fit to express an opinion that might, if acted on, ruin the country's trade. The factors which are involved in determining the success or failure of any tariff reform are so complicated, numerous, unknown, and uncontrollable, that the Government must organize some carefully controlled experiments under all kinds of commercial conditions before I dare express any opinion on the subject." One can scarcely imagine any parliamentary candidate getting elected after such a speech, yet to my irrational mind it is the only possible attitude on the majority of political questions, and on many medical ones. Perhaps herein is the reason why a scientifically critical mind makes a poor politician and often a poor medical practitioner. It is the horrid doom of the biological research worker who so often has to mistrust the apparent causes and effects of the events he sees happen in a test tube, to become more than sceptical of the loose explanations of the completely uncontrollable events which are recorded in the wide world outside his laboratory.

The world is subdivided into all sorts of herds—nations, races, social classes, professions, religions, and so on. Every individual is a member of many overlapping herds and sub-herds, each of which has its own prejudices, customs and taboos, and the urge not to offend against herd conventions is very great. Such traditions of the herd are scarcely founded on reason. At the time I was a medical student the controversy between certain London schools on the use of antiseptics in surgery was very keen. The contempt of St. Thomas's students, who were "aseptic," for King's men who were "antiseptic" was only equalled by the scorn of the King's students for the St. Thomas's technique. I do not suppose half-a-dozen of the hundreds of students expressing these opposite convictions ever bothered to find out that there was no statistical evidence in favour of either technique when practised by efficient surgeons. In this case, as usual, both sets of students blindly followed the leaders of their respective herds. Loyalty to tradition and the leaders of one's herd are worthy manifestations of herd instinct; without them the community life of a gregarious species would become unstable and chaotic, but at the same time they may become terrible barriers to scientific progress. If some great man, especially if he has a handle to his name as a mark of his herd's admiration, makes a statement on some subject he obviously knows nothing about, that is contrary to the pronouncements of some obscure investigator who has given his life to the study of the subject, nine out of ten people prefer to accept the great man's opinion rather than examine the carefully arranged evidence of the unadvertised scientific worker. And naturally so, since the great man knows he is right, while the obscure worker is full of reservations and doubts. As regards the rank and file, which most health administrators have to deal with, the ship's company, the industrial worker, and the regiment, the announcement that some famous film star or pugilist uses a quack medicine seems a far better advertisement than an endorsement by the whole College.
of Physicians. No one seems to use their reason to consider the very fact of a person being an exceptionally beautiful woman, or a champion boxer, means they must be physically perfect animals who can really have no need for medicine. I am not sure that public health administrators should not make more use of this peculiar quality of herd instinct and subsidize some notorious criminal, or other herd hero, to broadcast genuine health propaganda.

Loyalty to the great intellects of the past is another form of hero-worship which often has a stultifying effect on scientific progress. The amazing sway Aristotle had over the opinion of the educated herd right through the middle ages is the best example of this phenomenon. There is a story illustrating Aristotle's influence which I have probably got wrong in detail, but which nevertheless illustrates the strength of authority over reason. Leonardo da Vinci showed one of his patrons a dissection of the aorta arising from the heart. At the conclusion of Leonardo's demonstration the patron congratulated him on his lucidity, and generously admitted he could have believed the aorta did arise in the heart if Aristotle had not said it came from the stomach. He preferred to believe Aristotle rather than the evidence of his own eyes. Even nowadays many educated men have their pet hero of the past, such as Moses, Darwin, or Hippocrates, of whom it is sacrilege to suggest that he may have been at fault in some detail on which the advance of knowledge has shed further light. There is something pathetic about this type of partisanship, since these great geniuses would have been the first to adapt their administration, methods, or hypotheses to fit fresh facts or environments, and would have rebuked their disciples for appealing to tradition and authority rather than to observation and experiment. An aspect of group psychology which affects the public health is the behaviour of the antagonistic individual who, owing to some psychic trauma or other cause, generally suffers from an inferiority complex. Such people are prone to band themselves into sub-herds, against the authority of the larger group which includes them. In the medical herd the anti-vivisectionist and the anti-vaccinationist are the most obvious examples of this type. The "anti-fanatics" form a very difficult administrative problem. They are consciously perfectly honest in their convictions, but their power of dissociation and rationalization is so great that they often seem to the saner members of the herd to be absolutely unscrupulous and dishonest, whereas really they are only completely inaccessible to logic. In a way it is lucky they are so, since they generally destroy their own cause by overstating it, and making the most absurd accusations against those who dare to differ from them. If you should be fortunate enough to meet one of these people who has successfully dissociated his pet aversion from contact with the rest of his reasoning powers which are otherwise good, you will see better than in any other way what I am driving at. A friend of mine, in general a commonsense fellow, a keen sportsman and rider to hounds, was, he said, a great lover of animals, but for some reason
or other could not bear the idea of vivisection, which he had probably got from posters of eviscerated dogs begging to brutal-looking pathologists waving large knives at them. He took me to book for my brutal habit of puncturing guinea-pigs, but I never could persuade him that hunting to death the animals he loved so much, or wounding them with shot guns, was just about as cruel as giving a guinea-pig a hypodermic injection. It was impossible to convince him that we were both cruel from motives which may or may not have justified the cruelty, according to our respective notions on the relative values of sport and research. The more I said, the more convinced he became that I was no sportsman and was probably satisfying some perverted sex instinct by torturing guinea-pigs. It is most important to realize that these “logic-tight compartments” exist to some extent in all our minds, though rarely developed to the extent one sees in the “anti-crank,” and in more definite mental diseases. Occasionally, of course, someone in the minority to the general opinions of the medical herd hits on a great truth, as, for example, Lister, but such genius always gets recognition in the long run. Although educated authority should always be on guard against missing any real contribution to knowledge and critically examine all new work on its own merits, yet to-day, probably as the result of the lessons from history, the leaders of medical thought seem almost too tolerant. Every half-educated lunatic who gets smitten with the delusion that he has discovered a cure for cancer or something else seems able to collect a following. Orthodox medicine dare not be equally dogmatic in repudiating these “discoveries,” and if it does suggest that such a man is an ignorant fool, the latter never hesitates to compare himself to Galileo, or some other scientific martyr, whom a corrupt and jealous medical profession refuses to recognize, in case they find themselves out of a job. I think psychologically it is better entirely to ignore these people; certainly it is waste of good men’s time and money to undertake laborious researches to prove them wrong, because even if they are not completely inaccessible to logic with regard to their delusion, they are generally by the very nature of the mental process that must have led them to their so-called discoveries incapable of judging scientific evidence. It is wise, perhaps, just to state as simply as possible why they are wrong, for the sake of those among their followers who may be accessible to reason but not in possession of the relevant facts.

For the sake of argument, imagine all doctors to have no instincts and no other interests except the preservation of the health of their medical charges. The medical attendant of an individual will do what he thinks best for his patient even if others have to suffer in the process. In fact, this is often done when one member of a family contracts disease from nursing another by the doctor’s orders. If we assume that the medical man considered his duty was to the whole family, as well as the individual patient, and that his patient would suffer if moved, the family practitioner would then have to weigh the probabilities as to whether the harm likely
to accrue to the family as a whole, by not moving his patient, was greater than the extra damage to the health of the sick man if moved, and act accordingly. When we pass from the family to the institution, ship, or barracks, it becomes more obvious that the primary duty of the herd doctor is to keep his herd in as high a degree of health as possible, even if individuals have to be sacrificed. For example, a sailor may have had tuberculosis and appear cured, but it would not be fair to the rest of the ship’s company to let him return to the mess decks and risk his relapsing and infecting others; therefore his individual interests are sacrificed for the benefit of his herd.

Again, in the Royal Navy, there is no question but that vaccination against small-pox is a benefit to the whole herd, even if all its members have to suffer from a sore arm and a few days pyrexia. Because in such an environment as the mess decks of a ship a case or two of small-pox once introduced would cause an attack-rate of about 100 per cent among a ship’s company who had had no previous experience of either small-pox or vaccinia virus. And, since the Navy gives leave all over the world, in many places where small-pox is endemic, such a disaster would soon occur if vaccination was not enforced. On the other hand, should it be possible, as some experts argue, to control severe small-pox by quarantine and limited vaccination after the introduction of infection, it would not be to the benefit of the English herd as a whole to produce, in all its 40 odd million members, a mild indisposition in order to save a few dozen from a severe illness, or even death. If the above argument were true, the policy of universal vaccination would then have to be critically examined by the health dictators, who should decide whether the expected number of cases of small-pox would cause more damage to the herd than the amount of disability produced by the vaccinia necessary to prevent them. I may add that my private opinion is that, under present social conditions, malignant small-pox could not be safely controlled in a completely unprotected community, since, if alastrim is small-pox, it is not controlled, even in a partially protected population.

The primary duty of an officer in charge of a sub-herd is the health of his own group only; he cannot be expected to consider the health of other sub-herds. Sometimes the health interests of two herds clash. In such cases the matter should be referred to a higher authority, who would be the health administrator of a group of sub-herds and would see that no individual group was allowed to benefit at the expense of the whole herd. He would weigh all evidence produced by the doctors of any sub-herds whose interests were antagonistic, and always give his verdict in favour of the health of the majority at the expense of the minority. Similarly, it is the primary duty of a herd specialist, who looks after only an individual organ of the body, to do his best for those parts he is responsible for—the rest of the body is someone else’s business. As is well known, specializing on one organ of the body does tend to make a man lose sight of the other
parts. In a fleet on a foreign station an aural specialist pointed out that bathing was causing a lot of ear trouble. The prohibition of bathing was seriously discussed. As protector of the fleet’s ears, the aural specialist’s primary duty was to keep as many ears as possible continuously in working order; but the fleet medical officer, whose view was not restricted to the tympanum, considered the healthy habit of sea bathing did more good to the bodies of the herd as a whole, even should an extra individual ear or two suffer, and accordingly continued to encourage bathing.

Of course, in actual life, herds and health administrators have to compromise with each other when interests clash. But it is a salutary mental exercise to try and define what one’s duty as a herd doctor would be apart from all other interests and influences, because other interests and forces, which may be as important as health and scientific progress, sometimes clash badly with preventive medicine. Nowhere can this be seen better than at a meeting of one of the societies for the prevention of venereal disease. It is seldom that half a dozen men can discuss this subject as dispassionately as they would, for instance, the prevention of measles. The subject invariably drifts from prevention to ethics, religion, and herd customs, or the prevention of fornication, which is not the same thing as the prevention of syphilis. In fact, the control of venereal disease is so mixed up with the two strongest forces in animal life, sex and herd instinct, that it is unreasonable to expect any half dozen men all to talk reasonably about the subject.

For the sake of argument, suppose we imagine an all-powerful health dictator of the world, who has no instincts, no sentiments, and no interest whatever but to produce the healthiest human stock. He would survey the population of the world as a farmer does his herds. All individuals below a certain physical and mental standard, who could not, or would not, do enough work to keep themselves, and were, therefore, an uneconomical proposition and parasites on the rest of the herd, would be exterminated. War, of course, would be forbidden; our passionless dictator could not tolerate the absurd idea of allowing 8,000,000 or more of his prime selected cattle to blow each other to bits merely to gratify their herd instincts, any more than he would allow them, for the same reason, the privilege of preserving about the same number of physically or mentally inefficient animals comfortably housed in palatial asylums, jails and institutions, while good young stock was deteriorating for lack of the shelter and the fodder which was used to keep useless animals alive. Further, this supreme health dictator, knowing a little general biology, would realize that the unchecked fertility and fecundity of Homo sapiens was sufficient to replace, in a generation or two, any losses due to the wholesale slaughter of the unfit. He would, therefore, probably combine carefully selected breeding from what he considered the best human stock, with ruthless slaughter of those races with less physical and mental ability. He would in time be able to breed out such irritating characters of the herd as patriotism,
sentiment, and romance, and in fact eliminate everything which we poor irrational beings, on a lower plane of evolution, imagine make existence worth while. However, mercifully, all of us will have been dead for some eons before such a millennium of perfect health administration becomes possible. But I do think a nightmare of this sort makes us wonder whether more of the medical and social services might not be better employed in looking after the fit, and those who can be made fit, rather than in spending so much time on the care of cripples, cretins, and criminals. Truly, medical men are far too sentimental to do their job scientifically. I can offend none if I give myself as the horrid example of this statement. For about nine years I had been studying in a school environment between Homo sapiens and Bacillus diphtheriae, and was under the delusion (a delusion is a fact to its possessor) that I was about to make a useful addition to medical knowledge, provided that I could only get in another two or three years of observation. The school medical officer who, correctly, only considered his own medical charge, and did not care a button for posterity, asked me to immunize the school. Owing to a special set of circumstances, the decision to do so practically rested with me. After an exhausting mental conflict between my herd instinct and scientific duty, I yielded to the school doctor's importunity and the herd was immunized. The anticipated calamity followed. The diphtheria bacillus found the sudden alteration in its environment too great for its power of adaptation, and so diphtheria faded away, and with it the opportunity of this epoch-making discovery. Although a crime of the first magnitude had been committed against science—for what does a few children getting or dying of diphtheria matter, compared with the march of medical knowledge and the ultimate benefit of the many at the expense of the few—yet my reason is so warped by herd instinct that I actually count this crime a virtue. The above paragraph is, anyhow, a good instance of the limitations of one brain. On re-reading it, I find my introspective powers are not good enough to decide how much of it I mean literally or satirically: therefore the audience can take it either way their instincts urge them.

A critic may justly remark that all that has been said is instinctively known by the tactful and tolerant man, who realizes that neither himself nor others always behave rationally. But all are not born tactful and tolerant and, in my opinion, a little psychological reading is most helpful in getting public health measures carried out by those in authority and coaxing the herd we are in medical charge of—the sailor, the soldier, and the man in the street—into a healthier way of living.

Diseases of the herd are known as epidemics or endemics. There is no hard and fast line between epidemic and endemic disease, just as there is no sharp division between the acute and the chronic infections of individuals. Fatality, which is the ratio of the number who die of a disease to the total number who show its symptoms, is one index of the malignancy of the infection as it affects the individual; whereas mortality or the ratio of
those who die to the whole population at risk, can be used as an index of the malignancy of the infection as it affects the whole herd in contrast to the individual. The fatality is the probability of the average individual once infected with symptoms dying. The mortality is the probability of the average member of the herd, whether infected or not, dying. To the general practitioner, fatality is the more important ratio on which, in combination with clinical observations peculiar to each patient, he bases his prognosis. To the public health administrator, mortality and morbidity, which indicate the malignancy and extent of the disease as it affects the community as a whole, are the more practical figures. A comparison of these ratios for two diseases as they affected the same herd, while living under the same environmental conditions, will illustrate the relative importance of these common ratios to the individual and the herd. Among the 90,000 men who manned the Grand Fleet in 1918, the morbidity for meningitis was less than 2 per 10,000 per annum. The fatality was about fifty per cent of cases. The mortality was, therefore, less than 1 per 10,000 men. The corresponding figures for influenza were: morbidity 2,000 per 10,000; fatality 1 per cent, and mortality 18 per 10,000 men. The individual once infected with meningitis had to face a chance of dying which was fifty times as great as in influenza, but the probability of any member of the herd dying of influenza was eighteen times as great as his dying of meningitis, and the risk of getting influenza was at least a thousand-fold greater than of catching meningitis. The preservers of the Navy's health never had the slightest fear that meningitis would seriously interfere with the efficiency of the fleet, whereas at one time man-power was so crippled by influenza that it was doubtful if some ships could have left harbour. Therefore, the herd doctor need not waste much time over meningitis but, owing to its severity, meningitis is of grave import to the medical attendant of an individual. The position is reversed in the case of influenza, which is always a cause of the gravest anxiety to the health administrator, but to the infected individual a one per cent risk of death is almost negligible. These figures introduce one of the chief uses of simple statistics in practical medicine, which is to substitute a precise quantitative measure for that vague sense of proportion and relative values which everyone acquires, to a greater or less extent, by observation and experience. A man with no sense of proportion is nearly as irritating as a man with no sense of humour; in fact, humour depends on a feeling for relative values. In the example just given, the importance of meningitis and influenza to the naval herd is quantitatively measured, and I think the statistics show the relative importance of influenza to be much greater than many would have believed, because owing to the striking character of the meningitis cases, our intuitive sense of proportion might have led us astray. Moreover, sense of relative values, uncorrected by statistics, is often completely smothered by herd prejudices or sex instinct. The most blatant example of this is the disappointed lover who, having
been let down by one woman, declares the whole sex is false. Less forgivable is the man who condemns some method, or forms a general opinion, from one event. In the days when the Wassermann reaction was under trial, I more than once heard the remark made that the test was useless, because a case, which the speaker had decided was syphilitic, had given a negative reaction. In the first example I have not collected sufficient data to tell you what percentage of women are false, but as regards my own experience of some 50,000 Wassermann tests the results are false in not more than 5 per cent of clinically diagnosable syphilitics. This is as close an agreement as one can hope for between a complicated immunological reaction and clinical diagnosis. Statistical methods are really fundamental and are used unconsciously by all of us every day. For instance, when we stand at the hall door and debate with ourselves whether or not to take an umbrella, we are estimating the probability of its raining from our past experience of the frequency with which rain has fallen on similar looking days. The whole principle of the medical diagnosis of individual patients is based on statistics, which show the frequency with which certain signs and symptoms are associated in a series of cases. In the better textbooks an actual statistic is generally given, as, for instance, when Osler states that out of eighty-eight cases of pleurisy at the Johns Hopkins Hospital thirty subsequently were found to be tuberculosis. If this sample was a representative one, it becomes known that the probability of a case of pleurisy being tuberculosis is about one in three. In the study of disease collectively the statistical method has chiefly to be employed because, although the easier experimental method will generally produce quicker and more trustworthy results, there seems to be a very strong herd taboo against experimenting on human animals. All the same one sighs to think of all the good material, going to waste in jails and mental asylums, that should be available for this purpose, more especially as so few of us have either the ability or time to acquire a deep knowledge of statistical theory and technique. Nevertheless, if anyone really understands "the rule of three," and takes the trouble to acquaint himself with the common pitfalls in handling medical statistics, quite useful work may be done, especially in collecting data which can be used by the mathematical statistician. Undoubtedly the most difficult part of the statistician's manipulations is in attempting to correct his mathematical results for the way in which the data were collected. Many people distrust statistics because they are consciously or subconsciously frightened of them, and excuse themselves for lack of interest by some such fatuous platitude as, "that statistics are useless since they can be made to prove anything." Now, when a class of school boys are set a sum in arithmetic, between them they may produce a dozen solutions, but only one answer is correct and has proved anything. When, in addition to crass ignorance of arithmetic, a person commits all kinds of blunders in collecting his data, I suppose a set of figures can be maltreated to such an extent as to produce any sort of false result, but this
has not proved anything except the inefficiency of the would-be statistician. Probably in many cases the dislike of statistics is really instinctive, because when anyone is trying hard to rationalize evidence to suit his own case, he is prone to use indefinite expressions such as few, many, a negligible number, or a considerable percentage, instead of an exact figure. Any of these vague expressions of quantity could, according to circumstances and the individual using them, stand for five per cent. Therefore, as far as possible, all such terms should be avoided in a scientific paper. Even if the exact number is not known, often an approximation such as more than half, or less than ten per cent can be substituted for many or few. Sometimes an author will, without thinking, substitute a vague expression for a known number because he is unconsciously trying to sway his reader to his point of view. The reader should at least be given the opportunity of judging for himself what the writer considers a fair percentage or a negligible number.

In searching epidemiological literature I have often come across most interesting papers, which have been made most tantalizing, and useless for my purpose of comparing the behaviour of disease under different conditions, because the author would not report his figures, which it was obvious he must have known.

After excluding subconscious bias, I think by far the greatest difficulty in collecting material for medical statistics is the question of diagnosis. Accurate diagnosis is essential in order to recognize, with some degree of certainty, the thing that is being collected as coming within the definition of its class. Owing to obvious psychological causes, most people must tend to under rather than over-estimate the number of diagnostic mistakes which they make. All honest clinicians are fully conscious of cases they have had to put a name to where the probability that the name was wrong was not small; but the difficulty of obtaining any precise index of the magnitude of the average number of diagnostic errors seems almost insuperable. Those who, like myself, have performed post-mortems on their own patients who have succumbed in spite of, or because of, their treatment in the wards will realize how it is sometimes very difficult to rationalize what the patient was alleged to be suffering from before death with what is exposed at the autopsy. Cabot [2] compared the clinical and post-mortem diagnosis of 3,000 patients. He listed twenty-eight diseases, and the agreement between the pre- and post-mortem diagnosis declined from ninety-five per cent in diabetes to sixteen per cent in acute nephritis. Active phthisis was only discovered before death in fifty-nine per cent of the cases who presumably died of it. These startling figures were from an up-to-date hospital with all its advantages for accurate diagnosis. Therefore, if they are from representative samples they should be the measure of a better standard of diagnosis than what prevails under ordinary conditions of practice. Cabot says, "That a study of the details of the cases before and after death convinces me . . . that few of the mistakes tabulated could have been avoided." The value of this striking article is, however, greatly
diminished, since it is not clearly indicated how these 3,000 autopsies were selected. If they were a pure random selection, that is, if the series refers to consecutive deaths in hospital from the diseases mentioned, the results are a great eye-opener. But, on the other hand, suppose that these cases were examined post mortem only, because the clinical diagnosis had been in doubt, the figures would then have little significance. Again, to my mind, an unpardonable statistical sin is giving such percentages without mentioning the size of the samples they refer to. For example, if forty-one per cent of those who died of phthisis were not recognized in life, it gives one "furiously to think," provided the percentage was obtained from over 100 random autopsies. But if there were only ten cases of phthisis in this series, then the four missed cases which forty-one per cent would represent might have easily been an exceptional group, and the statistic would have little significance. However, this paper strongly suggests that between a quarter and half of the clinical diagnoses of cause of death at an up-to-date hospital were wrong. In my opinion, it is merely avoiding unpleasant facts to rationalize them away by comfortably assuming that the medical staff of this hospital were more ignorant than the average. Looked at dispassionately, the very fact that such figures found their way into print is a testimonial to the ability and conscientiousness of the clinicians concerned. A negligent or ignorant hospital staff would not have tolerated their publication. As regards medical diagnosis, the old aphorism that "a man who never made a mistake never made anything" contains a very great truth, so long as it is not used as cover by the man who never makes anything else. If Cabot's paper represents anything near the truth, it becomes possible to realize the difficulties of the medical statistician, who, if he is investigating the causes of death in a community, would have to allow for errors in diagnosis, which vary from five to eighty-four per cent according to the nature of the fatal disease. If these figures are a reflection of real facts they also demonstrate how precise figures correct our instinctive sense of relative values. I do not believe my clinical acumen to be worse than the average, or that I make over thirty per cent of false diagnoses, but, from the little I know of psychology, there are so many subconscious reasons why I should be loth to admit such a huge error in diagnosis, that I would not really be surprised if a statistician was able to prove, that on average, I did make a mistaken diagnosis once out of every three attempts. Recently, Raymond Pearl [3] has emphasized the fundamental importance of statistics in the study of "the biology of groups," of which subject preventive medicine is, of course, a part. He says: "If the group of living things be considered as a group or 'whole,' it plainly has attributes which are peculiar to itself." These attributes demand description and measurement, just as much as do corresponding attributes of the individual. Upon them will rest the foundations of any science of group biology. . . . Statistical technique furnishes the only means available for accurately and adequately describing and measuring the attributes of groups. . . .
Ordinary methods of description fail because they are fundamentally incapable of giving a description of the group (whatever its magnitude) in terms of anything but the individuals which compose it. Of later years, thanks largely to the inspiration of Major Greenwood, many workers in preventive medicine realize that this is true. But most of us are too dull, too tired, or too busy to acquire the difficult mathematical technique. The proper place for instruction in mathematics is at school or university. The subject "applied mathematics" bulks largely in many educational syllabuses, but the mathematics do not seem to be "applied" to the study of the attributes of the human herd. One might think the subject could be modified to do so with advantage to the young of a gregarious species, whatever their future careers. The elements of bio-statistics should form part of the herd's general education, instead of being considered a special subject only of interest to a few peculiar individuals.

I have kept you an hour discussing three fundamental subjects, to wit, evolutionary biology, normal psychology and statistical theory. As yet, these sciences, or at least the two first, do not bulk largely in the medical curriculum. Medical students, and I include all qualified men in this herd, have little enough time to digest the mental pabulum they already receive; but the little I have been able to glean for myself about these sciences has been such a help in connecting up in a rational manner so many incongruent and otherwise irrelevant facts and hypotheses, that I believe the time spent on these subjects is regained in the way they have made technical and practical medicine easier to memorize and understand. Therefore, at the risk of exposing my own ignorance, I have tried to prove that the prevention of disease in herds and individuals necessitates a proper understanding of their evolutionary biology and psychology.

REFERENCES.