body-cavity. Bacilli were also present in the blood of the carp, and on one occasion four bacilli were detected in a drop of blood from what appeared to be a healthy roach. In some the peritoneal fluid contained numerous bacilli, while in others only a few were visible; generally there was a relation between the number in the body-cavity and the number in the intestine, and they were most abundant in fish which had lived for some time in aquaria without food; but in trout which had been fasting for at least ten days, no bacilli could be observed in the peritoneal fluid. The carp which had bacilli in their blood had been living for some months in a small glass aquarium.

The difference between the roach first examined and those examined subsequently led me to endeavour to ascertain whether a sudden change of temperature would produce any influence in the number and distribution of the bacilli. As I anticipated, a rapid change from a spring to a summer temperature (from 48° to 65° F.) greatly diminished the vitality of all the fish experimented with, except the carp; and, as the fish became more and more exhausted, the bacilli gradually increased. If the temperature was raised from 48° F. to 65° F. in two hours, the bacilli of the peritoneal fluid not only increased in the roach, perch, carp, and eel, but they made their appearance in considerable numbers in the body-cavity of the trout, and on one occasion a number of small bacilli were found in the blood of a trout. Although the carp seemed to enjoy the rise of temperature, they were not exempt from the increase of the bacteria in the blood as well as in the peritoneal fluid. In some specimens of blood as many as eight short slender bacilli were visible in the field of the microscope at one time, and the peritoneal fluid in some instances swarmed with long and short bacilli, some of which were motile.

The above observations were confirmed by cultivations in gelatine agar-agar, and in infusions of fish-muscles. In healthy active specimens of the roach and perch, cultivations were easily obtained of the peritoneal bacilli, and generally also from the muscular fibres lying near the peritoneum, but in no instance did I succeed in obtaining cultivations when the blood, or the muscles from immediately under the skin, were used for infecting the culture-media.

Of the sea fish examined I have found bacilli—sometimes long and slender, sometimes short and thick—in the peritoneal fluid and blood of the whiting (*Gadus merlangus*), haddock (*Gadus æglefinus*), cod (*Gadus morrhua*), herring (*Clupea harengus*); and in the peritoneal fluid only of the flounder (*Platessa flessus*), plaice (*Platessa vulgaris*), and lumpsucker (*Cyclopterus lumpus*). I have not hitherto succeeded in demonstrating the existence of bacteria in either the peritoneal fluid or blood of the skate (*Raia batis*), dogfish (*Acanthias vulgaris*), or fishing frog (*Lophius piscatorius*).

There can be no doubt that the bacteria enter the body-cavity by penetrating the walls of the intestine; neither can there be any doubt that, having once established themselves in the peritoneal fluid, they do their utmost to find their way into the blood and tissues. Notwithstanding the presence of active bacteria in the intestinal canal, and the bile and pancreatic ducts, I have failed to discover either bacilli or micrococci in the body-cavity of either amphibia, reptiles, birds, or mammals, when in a healthy condition. Hence it may be taken for granted that, in the higher vertebrates, under ordinary circumstances, either (1) the walls of the intestine form an effective filter or screen, which prevents the passage of the bacteria into the body-cavity; or (2) that the living cells of the mucous and other layers so act on the bacteria that they are destroyed before they reach the body-cavity; or (3) that the cells of the peritoneal fluid effectively sterilize the bacteria which succeed in entering; or (4) that the bacteria are destroyed as they pass along the lymphatics towards the general circulation. Most fish seem capable of tolerating the presence of one or more kinds of bacteria in the peritoneal fluid, whilst others can even tolerate considerable numbers in their blood. It seems, however, that there is a limit to this toleration; for when the equilibrium is disturbed, when by a change of the surroundings the vitality of the tissues is diminished, the bacteria rapidly increase, and unless the tissues as rapidly recover, the bacteria may directly or indirectly cause death.

From the observations made, it appears that bacteria travel most easily along the lymphatic canals and spaces, the lymph-cells being apparently less able to arrest their progress than the blood-corpuscles.

As to the nature of the bacilli found in fish nothing has hitherto been determined. Olivier and Richet seem to think they are neither specific nor putrefactive. At first I thought they were putrefactive, but not specific. Having made some further experiments, I am now inclined to consider them specific and not putrefactive. It has been asserted by previous writers that bacteria are always present in the living tissues of fish, but this conclusion should be accepted with some reserve. For example, trout, roach, and eels, which were gutted immediately after death, and introduced for a short time into a 5 per cent. solution of phenol, and then transferred into sterilized water, remained unchanged for weeks. When examined, dead bacteria were found on the surface of the skin and in the peritoneal lining of the body-cavity, but no living bacteria could be detected in the muscles, nor did they appear in cultivations into which fragments of muscle had been introduced. As was anticipated, when the fish were placed in ordinary water, putrefaction at once set in. Hence, in the meantime, it may be taken for granted that while bacteria exist in the tissues of some fish even at comparatively low temperatures, they are not always, if ever, present in the tissues of others.

## THE PROGRESS OF SCOTCH UNIVERSITIES.

THE following three diagrams are meant to convey an idea of the progress of the Scotch Universities—Edinburgh, Glasgow, Aberdeen, and St. Andrews—in recent

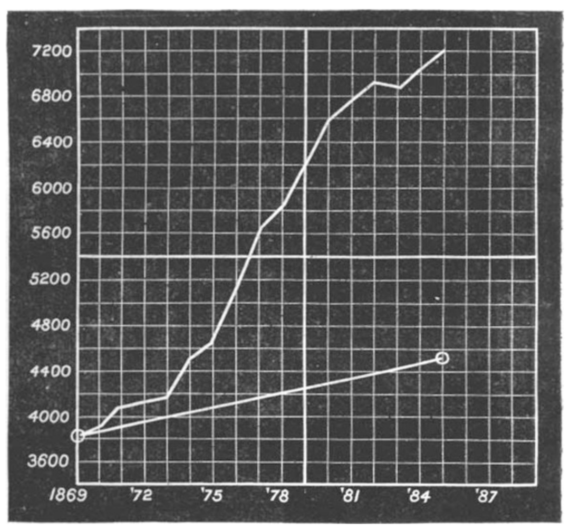


Fig. 1.—Total number of students at the four Scotch Universities (with line of population).

years. The first shows the total number of students each year from 1869 to 1885, and it appears that, with an increase of population of about 18 per cent. in that period, the total attendance has grown over 90 per cent. (The straight line indicates what the growth would have been at the population-rate.) The growth in Edinburgh is greatest, and the other Universities follow in the above order. Nos. 2 and 3 indicate how the students have been distributed among the different Faculties. The preponderance of arts students in Glasgow, and of medical in Edinburgh, will be noted.[1] As regards theology,

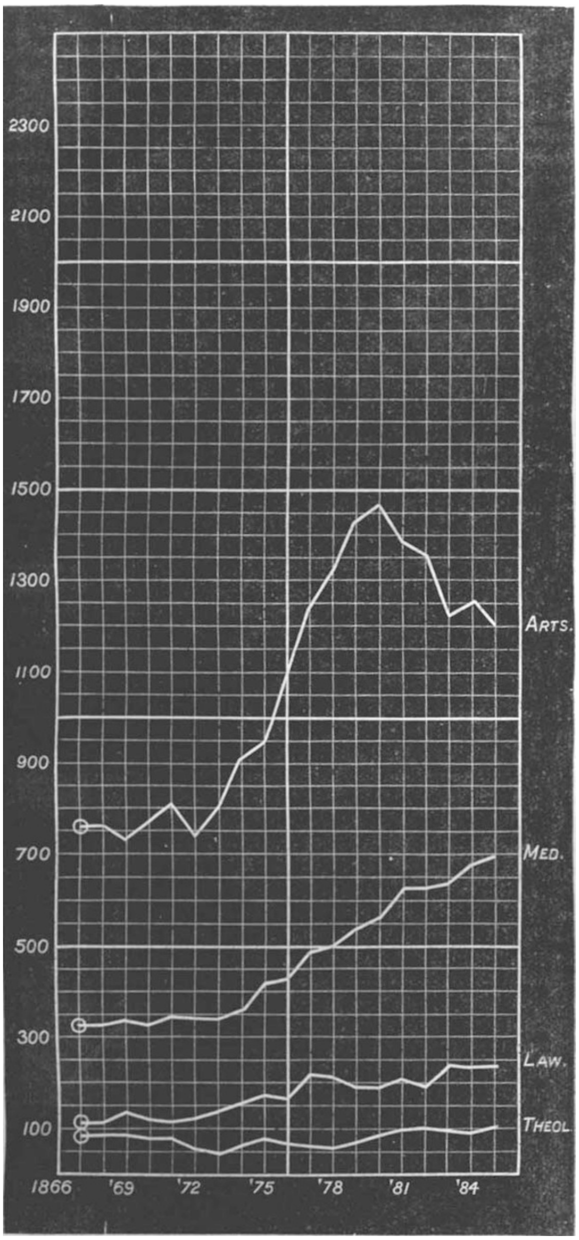


Fig. 2.—Glasgow University. Students in different Faculties (19 years).

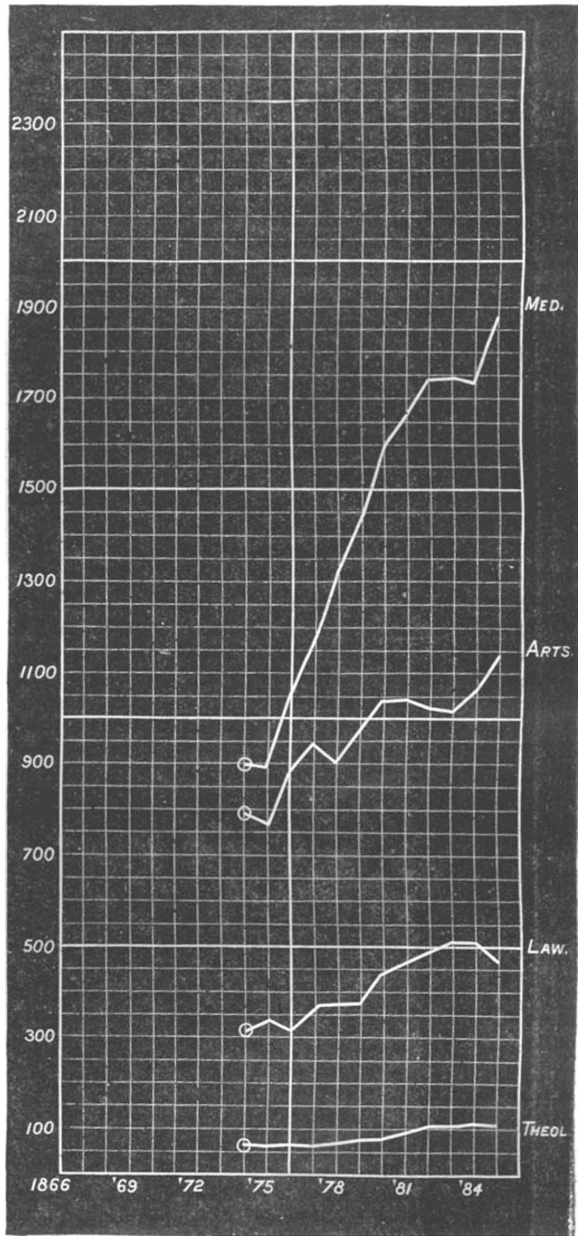


Fig. 3.—Edinburgh University. Students in different Faculties (12 years).

it is to be remembered that the students are only those of the Established Church; the two other large Presbyterian bodies having their own theological schools. (The statistics are taken from Oliver and Boyd's "New Edinburgh Almanac," and the numbers of students at each University include those of the summer as well as the winter session.)

A. B. M.

[1] It is right to state that in the recent classification of Glasgow students a small proportion are given as "Arts and Medicine," "Arts and Law," &c. These we have included as "Arts" students only.