physics laboratory for organised research. Much excellent work has been done, and it has been a great help since the war began, but the corresponding German institution was inaugurated many years previously, and the German Government spent four times as much money on it annually as the British authorities. Recently in 'Nature' a statement was published showing the relative number of chemists compared to population. The figures were:—Switzerland 300, Germany 250, France 7, and England 6. In Germany practically every youth received a technical training to fit him for the trade or occupation he is to follow. In South Australia nine out of ten of our children get no educational training whatever after leaving the primary schools.

"The war has brought us face to face with this great fact that we as a democratic community are trying to fight a nation with a very different form of government. With an almost despotic government like that of Germany it is comparatively easy to organise and systematise the work of the nation. With the democratic government under British rule it is an entirely different problem. The greatest difficulty we have to face is that no great change or alteration can take place unless the people are sufficiently interested to urge it, and in this case general apathy and unconcern form the most formidable obstacles. The people must realise that if we are to successfully compete against a nation like Germany we must have a more highly efficient system of effective and scientific education. Whenever any attempt is made to bring about a change vested interests of some sort stand in the way to block progress, and if they have any voting power they at once become a very formidable object. Voting power does not count for much in Germany.

"In Great Britain the old system of classical education which has been paramount in the public schools for so long has resulted in the filling of the highest places in the government of the country by men who have had no scientific training whatever, and who have little or no sympathy with its aim. It was long the custom at Oxford to contemptuously refer to all sciences as 'stinks.' That habit of mind has been reflected in our public men. When such men are compelled to call in the advice of the specialists they are unable to distinguish between a doctor and a quack.

"If the democratic form of government is to remain permanent after the war it is imperative that we should make ourselves as efficient as other countries. That is necessary if we are to hold our own in the continual struggle that is going on in times of peace as well as in times of war. The South Australian Government have already recognised this position, and have done something in the right direction. I have been very pleased to see the establishment by the Minister of Industry (Hon. R. P. Blundell) of a new department of industrial research. I hope that will be fostered and extended; but we have a lot of leeway to make up, and it will not be done in a day. It has taken the Germans 50 years, and we must lay the foundations on a sound basis in the more general scientific and technical education of the people. It will cost money, and the people will say that we shall be so bankrupt after the war that it cannot possibly be done. It must be done. It is the necessary food of the nation. In 1913-14 in South Australia we spent on all our educational and scientific activities 15/6 per head of the population. Munich in the same year with a population of 600,000 laid out £1 per head on primary education and continuation schools alone. American examples will be of interest.

Arizona has a population of 200,000, and its university has an income of £41,000 a year; Idaho, 325,000, £55,000; Montana, 380,000 (university and agricultural college) £100,000; North Dakota, 580,000 (university) £65,000, (agricultural college) £60,000; and South Dakota, 580,000 (university) £32,000, (agricultural college) £68,000. Nebraska with its 1,200,000 people contains four universities, whose income is £251,000. In South Australia, with 450,000 inhabitants, the total received by the University is £25,000. Who can measure the material benefits that have fallen to this State by the general application of more scientific methods to farming? All the money spent on agricultural education has been repaid a thousand times. Who would suggest that we have reached the limit of the possibilities in the way of scientific agriculture?

"We want to apply the principles of technical education so that all workers in all trades shall be trained so that they are efficient enough to be able to do the best work possible. We want the co-operation of trades unions and the employers, so that the education provided for each trade may be exactly what it needs. It should be the business of both trades unions and employers to see that no youth is rated as a capable workman unless he has properly qualified by taking the technical course. The man who has knowledge to give interest in his work is a happier and better man as well as a more efficient unit in the industrial system. A certain amount of work is being done in this State in this direction, but it requires to be multiplied by ten times and to be thoroughly organised from top to bottom.

"We should see that we train investigators for the special problems with which we must have to deal. This is a more expensive process for each individual student, but the rewards, too, are great. One man who can show us how to successfully combat an agricultural pest or utilise a single natural mineral product may easily bring more wealth to the State than it will spend on higher education in many years. A man cannot be trained completely for that class of work in an ordinary three years' course at the University or agricultural college. He requires to be a picked man, and we must provide research laboratories in which he can develop his specialised ability after completing an ordinary graduate course. It was stated in 'Nature' the other day that in the United States there are upwards of 50 corporations having research laboratories, costing annually from £20,000 to £100,000 each for maintenance. They are practical, hard-headed people, who would not do that sort of thing unless they found that the results justified it.

"I am glad that you have given me the opportunity to say a word or two on this subject, because it is the crying need of this State at the present time. More efficient technical and scientific education both in the lower and higher branches is of greater importance than any other political problem."

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GERMANS AND UNIVERSITY DISTINCTIONS.

The University of Adelaide some weeks ago addressed an enquiry to the other universities of Australia concerning the action it was proposed to take, if any, in the matter of alien enemies who had been admitted to university privileges. The question arose in view of the distinctions conferred upon Professor Penck and other Germans at the time of the Science Congress in August, 1914. It was subsequently alleged that Penck had acted dishonorably in taking certain information away from Australia and had laid himself open to the suspicion of being a spy. The professorial board of the University of Melbourne on Monday reported to the council:—"The University of Adelaide enquires whether this university has taken any action towards removing the names of enemy graduates from its roll. The answer is that this university has not taken such action, and that the university has no power to withdraw degrees conferred." The discussion of the report by the council was postponed.

Rejoin 7th June/16

BIG GUNS.

THE GUARDIANS OF BRITISH LIBERTY.

The much-talked-of 17-inch naval guns of the Germans were a myth. The battle off the coast of Jutland proved that now, as ever, the British lead the world in big gun design and construction. There is nothing on the face of the globe to equal the 15-in. rifle of the Queen Elizabeth; there is nothing that can resist the striking power of its huge projectile. Yet, though the British have produced this huge weapon, though the very safety of the Empire depends on superiority in gun power, the people of the Empire, generally speaking, know very little of the development of their invincible arm. Professor Chapman, in the Prince of Wales Theatre, University, last evening, delivered the first of a series of three lectures on "Big Guns," and there will be an opportunity to become more intimate with the marvels of science which have made the British Navy what it is to-day. In the full course he will give an account of the development of big guns, and some of the mechanical and engineering problems involved in their construction. Last evening's lecture, which was illustrated by lantern slides, was mainly historical, and dealt with evolution of modern weapons from the earliest projectile-throwing machines. The theatre was filled, and Professor Chapman kept the rapt attention of all present. Throughout he used simple language, devoid of all technical terms, and his descriptions were remarkably lucid. He had chosen the subject of big guns, he said, because it was intimately connected with the great events that were in everyone's thoughts, and it was at the same time a wonderful illustration of the way scientific methods had been applied towards efficiency. Progress of that sort might seem to many to be pro-

gress on the side of the devil, but so long as other nations were covetous of power, so long as human nature was what it was, the Empire must make itself efficient to protect itself. There was no Christian injunction, so far as he knew, to men to remain idle while their wives and children were being assaulted, and, in view of recent events, the British must thank God that they had devoted a certain portion of the brains of the nation and a part of its wealth to the production of big and powerful guns. (Applause.)

The Engines of the Ancients.

The lecturer began with references to the weapons with which Archimedes assaulted the legions of Marcellus at the siege of Syracuse. Archimedes had made a machine that would hurl a missile about 100 yards. What would he have thought of a battleship that carried guns which opened fire—as did the British battleships last week—at a distance of 12 miles? Archimedes' engines probably remained unsurpassed for hundreds of years, and it was not until long after gun power had been brought into use in Europe that the old projectile-throwing machines were set aside. Then the armor-plated knight gave way before the devilish efficiency of the chemical explosive. The ancients used a projectile-thrower in times beyond the range of history. That kind of machine was mentioned in the Old Testament when "Uzziah made in Jerusalem engines invented by cunning men to be on the towers and upon the bulwarks to shoot arrows and great stones withal." The lecturer read from Plutarch the story of the siege of Syracuse, and then proceeded to explain the classical types of war engines, the catapult and the balista or javelin thrower, and he dealt with the trebuchet of the twelfth century. His discourse contained many humorous touches. He related how among the playful habits of the besiegers in olden days was the

practice of throwing by means of the catapult the bodies of the men killed by the besieged, dead horses, and even cart-loads of manure, into the beleaguered town, to spread pestilence among its people. Dealing with the change in weapons of offence brought about by the introduction of gunpowder, the lecturer touched on all the theories of the invention of that explosive, but gave the credit of its general introduction to Europe to Berthold Schwartz, a monk of Friburg, about 1320.

Small Progress for 300 Years.

Then came guns, but for over a century they were used alongside the projectile engines of the ancients. One of the earliest recognised advantages of a gun was that it made such a thundering noise. At Crecy, it was written, the English were drawn in the form of an arrow, with small bombards between, which fired little iron balls to frighten the horses. The first print of an English gun showed a vase-shaped casting, an arrow being the projectile. Gradually the story of the development of the cannon was unfolded to the audience. The stories centring in the great bombard of Ghent, the celebrated Mons Meg of Edinburgh Castle, and other extraordinary and curiously-shaped guns were related. Finally a picture of a seventeenth century bronze cannon was shown, and then Professor Chapman directed attention to a model of a British field gun of 1850, lent by Mr. Pitt, whose father fashioned it when engaged at the Woolwich Arsenal. The development of field guns for nearly 300 years was practically stationary, he said, as the picture of the model showed. Bronze guns, he mentioned, had been used by the Austro-Hungarian army as recently as 1904.

Next Tuesday Professor Chapman will reach a most interesting phase of his lectures—the development and firing of the latest pattern heavy artillery.