The practical application of this method of controlling household insects and pests generally is to be found in checking the advance of great numbers of some particular insect, or in eradicating them where they have become thoroughly established. This method will be found very advantageous in clearing old buildings and ships of cockroaches.

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*ENGINEERING EDUCATION IN LONDON.**

JUDGED merely by the magnitude and diversity of the work actually carried out within its boundaries, London is by far the most important center in the world for civil, mechanical and electrical engineering. Its vast population includes a larger number of engineering employers and engineering workmen of every grade and in almost every branch of work than any other city can show. The demand for engineering instruction of every type is large and steadily increasing. Yet the provision now existing for engineering instruction can only be described—if we compare it with the needs of London in this age of steel—as trivial. Out of six millions of inhabitants the total number of engineering students above matriculation standard is estimated at 600. What provision there is seems good, as far as it goes, but it is ludicrously below the requirements of London, alike in extent, comprehensiveness, and variety.

The engineering instruction at present available in London consists mainly of three separate 'schools'—the Central Technical College of the City and Guilds of London Institute, University College and King's College—of a high standard of excellence in the somewhat limited work that they undertake, with a small staff of first-rate professors, and good, though not very extensive, equipment. Their main drawback is their limited size and scope, the high fees which they are compelled to charge, and their limitation to day students. Their work is, moreover, narrowly restricted by lack of space, lack of staff and lack of funds. They contain, in the aggregate, only about 350 students in all branches of engineering. Supplementing these three 'schools' (which are all situated in West Central London, within an area of three square miles) there are about a dozen less completely organized centers of engineering instruction, each with one or two professors and instructors of university rank, aided by subordinates dealing with the less advanced classes. These include the Finsbury Technical College of the City and Guilds of London Institute, where first-rate professors deal with junior students, and the several 'polytechnics,' dealing with all ages and classes of engineering pupils. These centers are conveniently distributed in the different parts of London; they provide both day and evening instruction, and their engineering departments are rapidly increasing in size and importance. Their equipment and workshop accommodation, so far as mechanical and electrical engineering is concerned, is usually good, though somewhat limited. Besides many hundreds of elementary students in various engineering subjects, they contain in the aggregate about 250 engineering students doing work of university standard. This work could easily be extended, by strengthening the staff and improving the equipment of the several institutions, to an almost indefinite extent.

If we turn now to different branches of engineering, it may be noted that (apart from the Royal Naval College at Greenwich, which is not open to the public) absolutely no provision exists in London for instruction in marine engineering and naval architecture. Though the Thames is still one of

* From the London *Times*.

the great shipbuilding ports, and this local industry, moreover, has lately shown encouraging signs of revival, no young man in the Thames shipbuilding yards or marine-engine works can get access to instruction in his profession.

For civil engineering some small provision exists of high quality. But the instruction is limited in scope, given almost entirely in the daytime, and barred to most students by high fees. The position of London, as the capital of a vast empire, the center of organization for important engineering enterprises all over the world, and itself the scene of great municipal and capitalistic works seems to call for a considerable extension in the scope and variety of instruction in civil engineering. In connection with this need may be specially mentioned the lack of any systematic instruction for the large and growing class of municipal engineers; the absence of any school of railway engineering, dealing, among other things, with permanent way construction; the need for specialized training in dock and harbor work, for which London is the natural center, and, indeed, the total lack of any adequate treatment of hydraulics (for which alone Cornell University has a fully-equipped and well-endowed department). Moreover, this is perhaps the place to notice that (beyond one or two courses of professional lectures) London has nothing in the nature of a school of architecture. It contains far more architects than any other city in the world, and annually adds a larger quota to the profession than any other center. But it leaves them to pick up their art in the old-fashioned way, and makes no organized attempt to provide modern instruction. The result is that, whether on the constructive or the artistic side, we lag far behind the United States, France and Germany.

The provision for electrical engineering, though lately much increased, is still inadequate, both in extent and in variety. Above all, there is lacking any adequate opportunity for research and instruction in the more advanced and newer developments. How much of the future of industry may not turn on the proper working out of the possibilities of high-tension transmission and polyphase currents? Where, too, is our school of electric traction, which will enable us to keep, at any rate, some part of this rapidly-growing industry in our own hands? It is not to our credit that, though Great Britain supplies the original ideas, the greater part of the equipment of the 'tube' railways has to be made in the United States and Switzerland.

Dealing with the matter geographically, we may say that, if all the existing centers were enabled freely to expand to meet the growing demand, and brought up to a satisfactory standard of efficiency and comprehensiveness, the greater part of the six millions of population would, as far as mechanical and electrical engineering are concerned, be adequately served. There would, however, still remain in the outer suburbs such important centers of population as West Ham, Croydon, Willesden, and Tottenham, containing in the aggregate over three-quarters of a million people, or as many as all Glasgow, needing engineering schools; and even within the county area additional engineering schools are required in the neighborhood of Hammersmith, Hackney, and St. Pancras. If these were provided the number of engineering centers within the radius would be raised approximately from 15 to 20, and it may confidently be predicted that the number of engineering students above matriculation standard could be, within two or three years, certainly trebled (*i. e.*, raised from 600 to, including all departments, at least 2,000); and would then still be far behind the number for Belgium or Saxony, with

which kingdoms—not with any one city—London has to be compared.

What is wanted in the faculty of engineering is, therefore:

1. Increase in staff of professors and instructors at existing centers—say £10,000 a year (£330,000).

2. Extensions at existing centers in buildings and equipment to accommodate additional students—say £150,000.

3. New centers—building, equipment, and endowment of engineering departments at—say seven at £50,000 (£350,000).

4. New subjects—provision for buildings, equipment and endowment of centers for marine engineering and naval architecture (£100,000); civil and municipal engineering (£100,000); railway, dock and hydraulic engineering, etc. (£100,000); electric traction (£100,000); architecture (£100,000), etc. We may say, therefore, that the faculty of engineering needs a capital sum of £1,330,000.

SCIENTIFIC BOOKS.

Bibliotics, or the Study of Documents. By PERSIFOR FRAZER. Third edition. Philadelphia, J. B. Lippincott Co. 1901. Pp. xxiv + 266.

The subject-matter of this book, not very clearly suggested by the title, is the methods used by the handwriting expert and by the chemist, in the identification of writing and the detection of forgery. A scientific man desirous of getting some insight into these methods—or into the best of them—will find this book good reading. It is written with a scientific bent. It considers handwriting much as a zoologist considers animals. The determination of the characteristics of a given handwriting is like the determination of the characteristics of a natural species. The older methods relied on general impressions or on the description of salient features; the newer methods rely on measurement of the details. A person's handwriting, like a natural species, is a variable thing, and the exact study of it must deal in averages and ranges of variation. "It will be readily conceded that at least two factors are present in the performance of an act which is often repeated. One is the general similarity, and the other is the variation in some details which prevents any two acts or results from ever being exactly identical. These are analogous to the two important factors of the theory of evolution, called, by Charles Darwin, hereditary transmission and accidental variation. In order to arrive at an ideal standard of similar recurrent actions, it is necessary to eliminate, as far as possible, the accidental variations. The most obvious way to do this is to take the average or mean of the records of a number of such actions." The first method devised by the author for arriving at the mean was the graphic method of composite photography. This appeals to the eye, and shows directly which parts of a signature are most uniform and which are most variable. A disputed signature may better be compared with a composite of several genuine signatures, than with any one of them.

The more exact method of averages, also devised by the author, begins with actual measurement of details; and it is the inconspicuous details that are most characteristic. The salient features can be changed more or less at the writer's will, or imitated by another person. But the little tricks of curvature and slant and proportions, the minutiæ of shading and alignment, as they are the expression of unconscious habits, so they cannot voluntarily be laid aside, and as they are undetected by the eye, so they cannot be reproduced by a forger. The most useful details for measurement are angles and the ratios of different lengths; these are very inconspicious, yet fairly constant, not changing with the size of the letters.

If, then, a signature is disputed, several genuine signatures are obtained, and a certain number of details are measured in all the specimens; the average measurements of the genuine signature are computed, and the measurements of the disputed signature compared with them. Close agreement throughout stamps the disputed signature as genuine; wide divergence as spurious. Some divergence is of course to be expected, and in fact complete identity is evidence of tracing. But just how much difference can be allowed? How sure is the expert of his decision? It does not appear that the theory