

## The Starting of a Phonetic Laboratory

I think it may be of some use to young lecturers, called upon to fit up a laboratory *ab initio*, to have the benefit of a colleague's experience in this matter, and I therefore give some account, in the following pages, of a small laboratory I improvised in a distant part of the world, together with considerations anent schemes more ideal than I was in a position to carry out. The laboratory I shall describe is an elementary one, not planned for research, nor equipped with the delicate physical apparatus required for advanced work.

The first question is about the room or rooms. It is not true that any small room will do for a phonetic laboratory, or, if it does, it may do very badly. Given ordinary comfort and quiet, light is the main requirement. I will assume the laboratory is in a warm and sunny climate, because, firstly, I am most familiar with such laboratories, and, secondly, because I do not know what remedy to suggest for the dull light of cold climates, other than artificial illumination, which I will speak of in connection with the use of the laboratory at night. We may therefore premise that we need light, ever more light. The possibilities are light from above, through the roof, and light from the side, through the walls. We will consider lateral lighting first. Assuming, for argument's sake, that the walls coincide with the four points of the compass, which wall should the windows be placed in? The precedent of artists' studios may suggest the North, but a northern light is one of the most depressing, nerve-racking factors that can be introduced into human existence. It is altogether wrong for a phonetic laboratory, where quiet of every kind,



including nervous quiet, is one of the first requisites. Still, it may be necessary to put up with a northern exposure, in view of the excessive heat of colonial summers. The true solution is to have both lights, the southern being the essential one relied on during all the main working part of the year, the northern one being counted on for the vacation. Outside shutters and Venetian, as well as inside light-proof, blinds are, of course, indispensable for all windows, not to mention mosquito-nets in some climates, although these are better dispensed with when possible, as they cut off both light and air. What proportion of the wall should the windows occupy? All. And what of the other two walls: should they have windows too? Yes. Filling how much of the wall's area? All. Of course, they may have frames to hold the panes, which should be a fair length, — not miserable little squares looking like a glass tartan. The best form of window is the balcony window, with glass down to the ground, or nearly so. It should be mounted (until more radical reforms can be introduced) like a sliding tram-door, for, in the laboratory, all space is valuable. These sliding windows might be some 15 ft. high, two rows of them being vertically superposed, with a wall-space of a few feet between, along which, reached by spiral staircases, would run a narrow gallery affording access to the upper tier. This system ensures complete ventilation, which is very necessary in a phonetic laboratory, on account of the varnishes used. Now about vertical lighting. Should the skylight be superadded to this orgy of light? Yes, if it can be controlled. No, if it cannot. In a cold climate, I would unhesitatingly recommend it, but, in a hot one, if it is to become a nuisance, it is better to do without it.

Having procured light and air for our laboratory, perhaps we ought to begin to ask what size it should be. We have already seen that it is to be high, since we have adorned it with a gallery; now there remains the question of its floor-area. We are assuming all along that it is to be an independent building, and we seem to be taking for granted that it is all «ground-floor». This is due to our conception of it as a colonial building. I must confess to a strong leaning to the frame-house type of edifice. Building in wood leaves room for modification in the future, which may need to be radical. Of course, it is not so economical



as the European might fancy. In Australia, the jarrah building is not reckoned to cost so immeasurably less than the brick one, and, if Public Works Departments do the construction, there is a fair chance of its costing more than an equivalent marble one in Italy. Still, all things taken into account, I am in favour of wood, the use of which virtually precludes any upper storeys. The only real objection to wood, save the danger of fire, which is negligible, is the torrid heat in summer. For three months it may be practically impossible to work in the laboratory in the day-time. This can be avoided with brick, on condition the wall is 18 inches thick. On the whole, it is best to have a second laboratory, for the summer, in the hills, or on the mail-boat, or somewhere away from the blazing sun. — To come back to the original question of how large it should be, the answer is : as vast as possible. Why? Because you will soon discover that the blessed Council won't let you have a quarter of what you want; so you had better ask for a lot, and you may get a little. A good laboratory for elementary purposes might measure 70 feet by 40. As for people who think rabbit-hutches are big enough for labs., I can only advise them to live in them themselves, and give us their luxurious homes for scientific purposes. The laboratory as described might be 35 feet high. The various dependencies, of which more anon, are not included in this estimate. Such is the modest ideal I set up. Now let us compare with what I actually had in Australia.

The University of Western Australia being in the act of emerging from its shell (after years of brooding over by the Black Swan), when I reached Perth, accommodation was very scant for all departments, although the lion's share naturally fell to the reputedly more important ones. The result was that, for Modern Languages, I had one room in all, considerably smaller than the size I have specified for the laboratory, and it had to do service as lecture-room as well. This was a great inconvenience, but it will afford me the opportunity of describing a lecture-room adapted for phonetics, which, in a more ideal building, I will suppose built opposite the laboratory, on the north side, say 25 yards away. I will deal with the lecture-room at once, so as to be able to dismiss the subject.



The building might be the same size as the laboratory, and have the same orientation, so that it would form its strict counterpart. Everything we have already said, concerning the lighting and ventilation of the laboratory, applies equally to the lecture-room. The inner fittings of the room will alone be different. The first thing required is something for the students to sit on and write on. My own preference is for cane chairs and wooden tables, about 3 feet by 2. This allows of emptying the room, when needed for other purposes, and also of cleaning it thoroughly.

The next requirement is a platform for the lecturer. It should be a good height, unless the seats are arranged as in a lecture-theatre, which is an absurdity in a small room, and quite spoils it for all other purposes. 18 inches will be found none too much. The area of the platform should be immense, in case the lecturer indulges in the healthy habit of walking about while speaking. 30 ft. long by 10 ft. broad will be right. It should be entirely covered with cocoanut matting or rubber. It will need to be fitted with a counter 3 ft. 6 in. broad, running its entire length, but capable of being folded down at the centre, leaving a gap of 6 ft., in which a movable, but very steady, lectern can be placed. The whole counter must, moreover, be capable of folding down, in such a way as to leave only a strip 6 in. broad running the whole length of the platform, which strip is immovable. It will be observed that this nowise interferes with the folding in the middle, which is simply a section of the whole counter. The height of the counter will depend on that of the lecturer: it should not be high. Although it must be capable of folding, if necessary, it should be perfectly solid, and may have fittings, such as drawers, etc., which will prove useful.

Immediately behind the platform, runs a screen for the blackboard, etc. This, as well as the platform, which may be in two sections, should be easily movable, not only because the room may be required for other purposes than lecturing, but so as to allow of placing them in other positions and other parts of the room, e. g. at the opposite end. It is convenient to have the screen made of light wood, and mounted on pulleys, so as to be able to raise and lower the two halves, or at least the upper half, at will. The upper half will carry an aluminium-finished lantern screen, wound on a



roller. It will also have, stretched over its entire surface, a strip of blackboard cloth — an American product — 30 ft. by 4 ft. 6 in., or wider, if procurable. Besides this, American blind-rollers, a yard or more long, will be mounted all along the upper blackboard: at least half-a-dozen of them. Instead of blinds, they will bear strips of blackboard cloth, or diagrams and maps. The lower part of the screen will also be provided with blackboard cloth. This will give a total blackboard of 30 ft. by 9 ft., not counting the blinds. At either end of the platform, the 5 ft. free will be occupied by a strip of blackboard cloth, 4 ft. 6 in. wide and 30 ft. long, mounted on a roller, like an endless kitchen-towel, i. e. forming a closed circuit, the roller being borne by a wooden horse. A somewhat heavy roller, placed loose inside the cloth, at the bottom, will be found to keep it in position satisfactorily.

All these arrangements will mask the light from one end of the room, the Eastern probably, but that is no reason for condemning the windows. If fitted on the tram-door principle, they can still be used to much advantage for ventilation, and, should the platform and screen subsequently be shifted, they will be restored to their full rights.

Diagrams are a necessity in a phonetic lecture-room, but, where the walls are mainly glass, there is not much space for hanging them. A series of diagrams showing the articulations can be fixed above the upper blackboard. The screen can be so made as to afford a free surface of soft wood, 30 ft. by 2 ft. 6 in., for this purpose, or it may be made 40 ft. long, in order to accommodate a more extensive series. In this case, the strip of soft wood must be at least 15 ft. from the floor, in order to escape collision with the endless blackboards. The only series of such diagrams, so far published, is that by Rausch, issued by Elwert (Marburg). Despite its deficiencies, which are not a few, we must be content with it until superseded. Six of these diagrams have been reprinted by Dent & Co, and these I used at Oxford, for the Foreigners' Course; but, as they are only vowels (— anything but correctly drawn), it is better to have the more complete original set. The publishers very wisely abstain from mounting the diagrams on pasteboard, and, of course, in a hot climate such a thing cannot be dreamt of. The other dia-



grams that may be required permanently are sections of the vocal organs, and sound-charts. Of the former, there are drawings, much beyond life-size, by Zünd-Burguet, Bremer, and others. Or one of the complex figures in Testut's *Anatomy* may be photographically enlarged, but the most renowned diagram of the head and larynx is the one in v. Luschka's book, which may be enlarged, or copied in black and white. Printed sound-charts are hardly available for more than a few of the chief languages. Others can easily be drawn, especially if it is desired to use a script different from that of the Association, which is, by no means, of commanding merit. We would here like to caution the young lecturer against attaching much importance to script. The English school seems to think it a subject *per se*, and even M. Passy used to indulge a good deal in dictation. That is all right in its way, but it is typical of the first smattering stage only. Unfortunately, some students never get beyond it, although they take a pride in becoming proficient in this kind of hieroglyphic long-hand. The experimental school attaches no importance whatever to script. *Re* the best editions of sound-charts, I would recommend, for English and French, those prepared by Mr. Jones, and published by the Cambridge University Press. There are, besides, Prof. Vietor's charts, issued by Elwert (Marburg), and Prof. Rippmann's, to be had of Dent & Co. All these diagrams may be hung in front of the platform, if there is no other available space.

As the main lantern will probably stand in the lecture-room, at the end remotest from the platform, or maybe in the central aisle, we will discuss the type at once. My unhesitating advice, if the money is available, is a Leitz grand, by which I mean the £ 120 size. If this is impossible, there are many nice things, in a smaller way, manufactured by the Bausch & Lomb Co. One of these I would suggest for the supplementary lantern, if the Leitz mammoth can be had. This supplementary lantern is placed at one end of the platform, say the southern end, while the screen to receive the picture is mounted on a roller affixed to the north wall, at the other end of the platform. The picture will not exceed 7 ft. square. Both the lantern and screen may be slightly slanted, in order to attain greater visibility for the public. Another system is to employ a screen inclined at an angle of 30° to the



floor, and placed above the upper blackboard, the lantern standing on the counter, tilted. This supplementary lantern only serves to show slides and specimens by the way. For a whole illustrated lecture, or for the more delicate specimens, the large lantern is resorted to, and is run by an assistant *who knows how to focus*. These lanterns will require pretty heavy wiring, and this brings us to the question of artificial illumination for the lecture-room, and, incidentally, to that of table-lamps.

At Perth, I was fortunate at least in the matter of electric lighting. In a relatively small room, I could command 1,800 CP. of incandescent light. I rarely used it all simultaneously, but I should consider 4,000 or 5,000 CP. (not counting table-lamps) none too much for a lecture-room 70 ft. long, by 40 ft. broad, by 35 ft. high. I am quite aware that this is about eight times what the old fogeys would think appropriate, but they are they, and I am I.

Now about distribution of light. We will assume there are to be six rows, each of six chairs and tables, although a room of this size can easily accommodate twice that number. Assigning a table-lamp with 100 CP. nitrogen globe to each table, we dispose of 3,600 CP. Close above each table, there should hang a 100 CP. globe, with shade: this will mean another 3,600 CP. A theatre-batten, properly made, so as to keep the light from the audience's eyes, and throw it all on the blackboard and diagrams above it, demands at least 750 CP. A 100 CP. lamp, also with a reflector protecting the eyes of the public, will be hung before each of the endless blackboards. With 50 CP. for the indispensable watch-lamp in some back part of the room, we reach a total of 8,200 CP.; to which must be added 100 CP. for a carefully-shaded lecturer's lamp, and 100 CP. for two other globes (with shades), to illuminate the counter, — in all 8,400 CP. (or 4,800 CP. without the table-lamps, which play no part in the general lighting of the room).

The table-lamps are intended for throwing light into the mouth. They ought to be of the nitrogen kind, and entirely darkened, save for the aperture through which the light is allowed to shine into the mouth. It is best to take advantage of this dark casing, which may be done in various styles, to silver, and thus reflect more light. The lamps must be used in connection with concave shaving-mirrors mounted on heavy leaded stands,



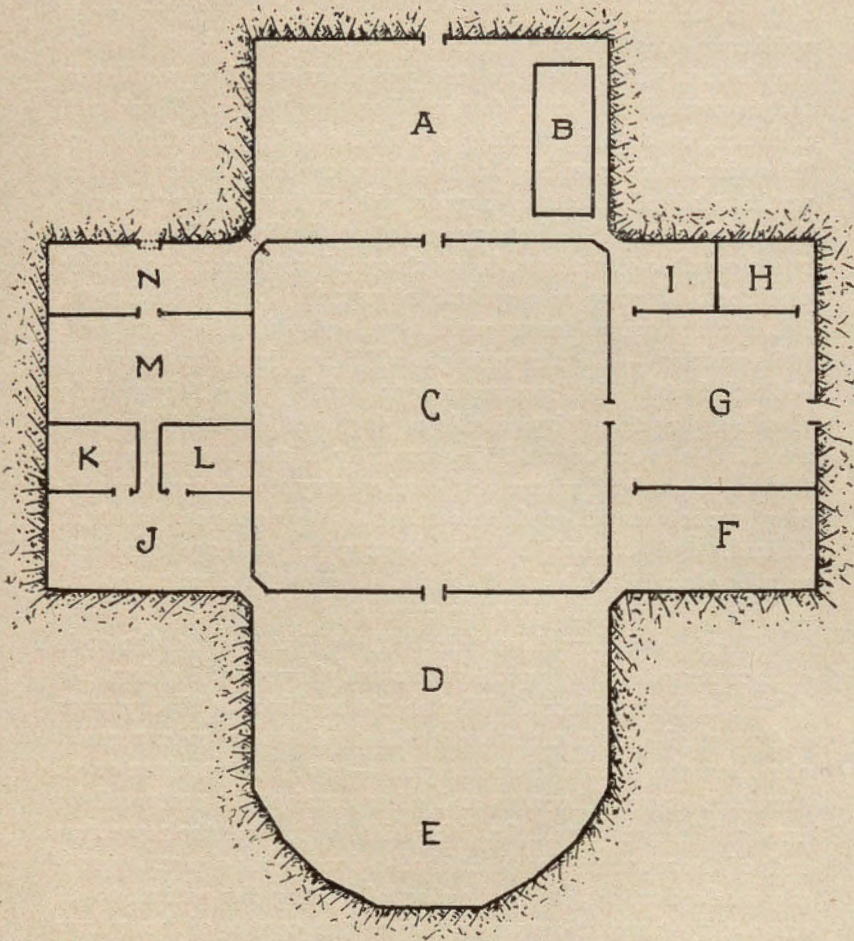
— one for each table. Battens and extensions will provide the necessary current: no other system of wiring is appropriate for movable tables. At Perth, for lack of table-lamps, the battens used to be let down bodily, with the powerful lamps in their sockets, just behind the students' heads; but, although there are some advantages, as regards light, in this arrangement, it is by no means practical, owing to the great risk of breakage of the globes.

Full control of the lighting of the room must be afforded to the lecturer, by placing the board with all the switches over the platform, — say, under the blackboard. The plugs and keys for the lanterns, and any motor force that may be required, should be placed beside the switch-board. The only other requirements are: gas and water, which must be laid on at one end, say the southern, of the counter (together with a sink for the latter); electric bells communicating with all the other parts of the buildings, to summon the assistants and students; and telephones and acoustic tubes, for similar purposes. Coconut matting or rubber, if the latter can be afforded, should be laid down the central aisle, both sides, and the further end, of the room, as well as in front of the platform, for silence is golden in a phonic department.

To revert now to the laboratory, we have said that it would be the exact counterpart of the lecture-room, and stand some twenty-five yards from it. But, in wet weather, it would be convenient to have a connecting wing, and, moreover, there are dependencies without which it can hardly exist: viz., a store-room and dark-room, at the very least, and a room holding the books that cannot be dispensed with, — in other words, a library. We will therefore ask the architect to build two wings, connecting the two original buildings, each wing to be 70 ft. long by 40 ft. broad, thus making perfect symmetry. To the laboratory proper a bow-window must be prefixed, in order to get the full advantage of the southern exposure. This will require to be brick-built, as it will include an upper storey, 17 ft. above the ground and extending, itself, 17 ft. upwards. Access will be by spiral staircases at either end. At no part will the bow-window be less than 15 ft. deep, save where it tapers off at the extreme ends, and, in the middle, it will attain a full 25 ft. The long upper gallery thus formed will be best cut



PLAN OF LABORATORY, ETC.



A — Lecture-room.  
 B — Platform.  
 C — Quadrangle.  
 D — Laboratory.  
 E — Bow-window.  
 F — Private room.  
 G — Library.

H — Drawing room.  
 I — Antechamber.  
 J — Preparation room.  
 K — Photomicro room.  
 L — Dark-room.  
 M — Store-room.  
 N — Lumber-room.



off from the rest of the building by a double glass partition, made up of tram-doors fully glazed, the object being to shut out all noise from below, when necessary, and yet allow complete ventilation and transmission of light to the laboratory below. There will, of course, be a door at either end of the gallery, at the top of the stairs. A narrow ledge, running the length of the double glass partition, affords access to any part of it, without passing through the other parts. This is to permit of subdividing it, if necessary, into a number of sections, in which case I would advise movable partitions, allowing, at any time, of restoring it to its full length. It is intended as the Measurement room, and will, naturally, thanks to its position (— I am assuming it will have a free view before it), be flooded with light, from morning to evening. It will be entirely glazed, and protected by suitable awnings, etc., but it will be quite unutilisable in summer : it is essentially a room for term time. It must be provided with a movable, but very steady, counter, running its whole length, made in sections, so that gaps can be left, if desired, and of height variable at will. A large cupboard may be placed at either end of the gallery. Shallow cupboards can also be arranged below the counter.

The bay-window downstairs will be fitted up in the style of a conservatory. Tropical plants and flowers will relieve the dulness of the laboratory. Why should our lives be all dry work and no play? In the central part will stand, on one side, a grand piano, on the other a chapel organ, — not a harmonium or an American organ. Lounges and other comfortable seats will be arranged around them. On either side, but nearer the respective ends of the room, will be placed half-a-dozen deck-chairs. A properly-made dentist's chair, allowing of rocking the patient to an angle of  $150^{\circ}$ , might be put exactly at the centre of the gallery above, if it can be afforded. (They are atrociously expensive.)

We will not enter into minute details, concerning the fittings of the laboratory : we will only say that they must aim at great convenience, and be in excess, — not the reverse, as is usually the case, because we have been living up till now in the Dark Ages of starvation for science. That will have to change. There must, of course, be water everywhere. There will probably be a small fountain (say, 8 ft. in diameter) between the organ and the piano-



forte. Gas must also be available in every part of the room, piping and fittings being at all times kept in absolutely perfect condition, and rubber tubing being totally, definitively, mercilessly prohibited, as well as in all other parts of the building. I have known an eminent scientist die of this perpetual inhalation of gas, which he stupidly thought of no account. Only the best flexible metal tubing frequently and *thoroughly* tested should be allowed, and the very smallest possible amount of that. As for electricity, it must be available everywhere, without the need of long extensions. Wiring is so cheap that there is no excuse for stinginess here. The distribution of light will be different from that in the lecture-room, but it need not here be determined in detail, as it will partly depend on the way in which the instruments are placed about the room, which I propose, with a few exceptions, to leave to the lecturer's caprice, because I think it does not greatly matter. Powerful nitrogen globes will be used for the general lighting of the laboratory, which cannot afford to be so relatively dull as that of the lecture-room, where a concession is made to students' passion for darkness: atavism, I suppose, — especially marked in women and the vulgar, conventional, undeveloped type of man. On the other hand, fewer table-lamps will be required.

We will now, before speaking of the apparatus, describe the other dependencies.

In the West wing, the first room we reach, coming from the laboratory, is the Preparation room. In it are performed all the more or less dirty operations, which it is better to keep the laboratory clear of. Sinks and water, as well as all other conveniences for such work, will be available everywhere in this room, which will run right across the wing, being 20 ft. deep by 40 broad. Beyond this, a passage leads to the store-rooms, and on either side of the passage is a room 15 ft. deep by 20 ft. broad, or a trifle less, as the width of this passage has to be taken off the total 40 ft. The passage may be dispensed with, if preferred, — access to the store-rooms then being through the more westerly room, while the Dark-room, looking east, would be reached by one of those winding ways that do away with the need of a door: really a great convenience in a dark-room. The Dark-room must be fitted



with *every* appliance to save labour. The room looking west is also more or less a dark room : it is reserved for photomicrography. In it stands the optical bench adapted for the purpose, and the accessories that accompany it.

The Store-room lies beyond these two rooms, and occupies the whole width of the wing — 40 ft. : its depth is 20 ft. It leads into another similar room of slightly less depth : 15 ft. This last room of the wing, we will call the Lumber-room : it is intended to hold the coarser stores and such articles as it is desired to keep, although not in immediate use. I will here enunciate a rule, to which I strictly adhere myself : never throw away anything, — there is nothing that will not come in useful, sooner or later. On this principle, the Lumber-room will not take long to fill, but, as it is 35 ft. high, a good deal of stacking is possible. Still, it is evident that we are going to be crowded, and that we have really started off on too small a scale.

As for the East wing, it begins, coming from the laboratory, with a Private room for the lecturer, 20 ft. deep by 40 ft. broad. Then follows the Library, 35 ft. by 40 ft. The last section of this wing is divided by a partition into two parts, each 15 ft. deep by 20 ft. wide. The more easterly one is a Drawing room, fitted up for the making of diagrams and other large surfaces; the more westerly room is an antechamber to the lecture-room, where the lecturer keeps his gown, arranges his notes, just before stepping on to the platform, and sees students after the lecture. I would make a practice of never seeing them anywhere else. The Private room should be absolutely private, never entered by any one but the lecturer, save, once a month, a domestic to clean it, under the lecturer's immediate supervision. It should have doors, communicating respectively with the laboratory and the library, situated at its western corners, so as to preclude all undesired draught in the rest of the room. The doors of the antechamber should be in analogous positions. As for the Drawing room, access to it would be from the Library. In each corner of the Library might be placed a turning photograph-carrier, able to accommodate large diagrams, and capable of being easily manipulated, so as to expose any one of the phonetic diagrams to the best light.



Having to deal here mainly with the laboratory, and not the library, which is its indispensable complement, we will not stop to consider even the most summary catalogue of books required. Suffice it to say that it should be complete in its way, and by no means confined strictly to Phonetics, on which many other sciences have a bearing more or less direct. Do not pay the slightest attention to what people may think (— remember, we are still in the Dark Ages), but buy anything you think fit, in the beard of the Academic Inquisition. They would like to roast you, but, if you are fortunate, you may go unscathed. Buy books on psychology, on physiology, on physics, on music, on æsthetics, on geography, on anthropology, on anything under the sun that may serve to stimulate the dull intellect and bring new life into the conventional old body academic, — not such a bad old body, on the whole, considering that it is as old as Methuselah. Another point is that you have got to have this library, and not have it merged in the general library. At Perth, there was great opposition to departmental libraries, and, in the end, they were cut down to mere offshoots of the main library. This is altogether wrong. The main library of a university is a place to show visitors, and in which to keep the books that no one reads; also for loafers wanting to pick up general knowledge, without any particular object. By all means, have one, but keep it for this purpose. It is most useful as a storehouse for useless books that cannot be dispensed with. (I expect the English Medal for this last sentence.) It is a good place for the old dictionaries that are too heavy to be consulted. (Of course, you will have an Encyclopædia Britannica in your phonetic library: mind it is the India-paper edition.) The general library is a splendid institution, provided it does not swallow the technical books on the various subjects: these it cannot by any means digest, and should not want to have. As a matter of fact, it is better to have most books in duplicate, if you can afford it, and one of the copies can be left in the general library. Of some books, you need duplicates, and even triplicates, in the departmental library itself. Moreover, it should be ascertained by telephone, before lending a book to a student, that the duplicate is not out also. This applies to both the general and the departmental libraries. Of course, books must be lent to take



home (— no work is possible, if they are kept under lock and key), but a little judgment is required to determine how long it may take to replace the book, if, for any cause, it is not brought back. Some students are very unscrupulous. For example, at Perth we had four general histories of French literature; a few days before a terminal examination, one student took out the three largest, and, when I remonstrated, the general impression got about that I did not want books taken from the library. By all means, take out books, but not those of a general character, of which there are only a few for each subject, and which, if lost, cannot, in remote parts, be replaced in much less than a year. Do not, for instance, insist on carrying off both volumes of the only copy of Rousset's *Principes*. Of course, half-a-dozen copies of such books as these are required in a phonetic library that is not meant merely to be looked at.

The library, the lecture-room, and the laboratory all open on to the inner quad, around which they are built, and which they entirely shut off from the outer world. This quad can be made very pretty, if it is wished, and it ought to be. I will leave its planning to individual fancy, but there is one thing to be proscribed, and that is verandahs. No cloisters, if any work is to be done downstairs. They may be ever so picturesque and peripatetically perfect, but they cut off light, without affording any real protection from the sun. So, let us have no vestige of a verandah to any part of the buildings. The sun will be kept out, as far as that is possible, by means of shutters, as already said, and thick awnings, like those used on board ship. If they are chosen and made with the honest intention of being some use, they will prove vastly more effectual than any verandahs ever conceived by benighted colonial brains. I will make a suggestion, which is a mere idea, never put to a practical test by or for me. In order to attenuate the terrific heat, inevitable for several months in the year, in the bow-window-conservatory and the upper gallery, water might be pumped up, and allowed to run down over every pane of glass of which they are composed. The mechanical arrangement would be quite simple, but this presupposes that the glazing is perfect, and that all frames are of metal (zinc, or *aluminium?*). I do not know how far this would actually cool the inside



air. The awning would be suspended outside, above the glass, at some little distance from it. The notion is taken from the pork-butchers' shops, which, in Australia, often have windows with water running down them, between two sheets of plate-glass, I believe. It need hardly be added that there will be a plentiful supply of electric fans in the laboratory and all the other rooms, including the upper gallery.

The next consideration will be apparatus for our laboratory. We have already said that we leave out the delicate things for advanced work.

The first requirement is a kymograph, or better two. The larger one must be as perfect as such machines can be made up till the present. That is not saying much. I believe they can be made in England and the United States, and I see no reason why they should not be built in at least one Spanish workshop. So far, however, the choice has usually lain between a Teinturier and a Zimmermann kymograph. I hear great praise of the 1,000 Mk. kymograph by Zimmermann, as used in the Phonetic laboratory of Hamburg. I have not seen the apparatus, save in engravings; so I can express no opinion. A good deal is made of its being a vertical kymograph, which is supposed to make the action much more frictionless. Personally, I confess that my present views are hardly in favour of the vertical position. I can see little but drawbacks in it. It may diminish the friction for the cylinder (— a mainly theoretical contention, provided the horizontal *aluminium* cylinder is perfectly mounted on conical and, if you will, even jewelled bearings —), but it increases it for the chariot, if displaced by means of a helicoidal shaft. (This adverse factor can, of course, easily be eliminated. Apart from this, the tambours have to take up a most awkward position, with the pens clinging to the cylinder like monkeys up a tree. If there is any modification to be made, as there usually is before each sheet recorded, it is very inconvenient and uncomfortable to get at tambours and pens. It is next to impossible to smoke a cylinder evenly while it stands vertical: it almost has to be placed horizontal for this purpose. Lastly, it is difficult to write anything on a vertical record; and it requires some practice and skill to remove a sheet



from a vertical cylinder. Practically, all these operations will be performed with the cylinder in its horizontal position, and it will only be set upright at the moment of recording, but I do not quite see why. In fact, Zimmermann, in his catalogue, shows some kymographs capable of either vertical or horizontal action. His workmanship is reputed very good, and the smaller things I

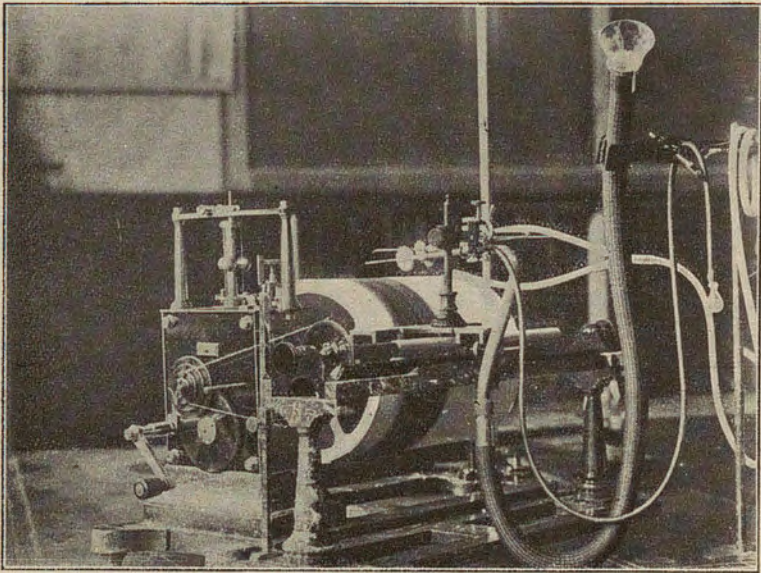


Fig. 1

have seen of his make certainly bear this out. But I do not think his prices very soft. £ 50 is a fair price for a kymograph : it is no catch, being, indeed, fully as much as is asked for the French machines. These possess the advantage of being specially constructed for phonetic purposes, whereas the Zimmermann kymographs are not specifically intended for phonetics, or were not originally. There is not much to be said against the Teinturier apparatus, save that it is irregular, — a defect it probably shares with all other kymographs. The latest form of it will be seen in the annexed photograph (Fig. 1), which shows the machine sent to me at



Perth. It will be necessary to insist on a star-wheel, which the makers never take the trouble to insert, and which serves the purpose of preventing more than the central part of the spring being used. A proper handle and pinion are indispensable to wind the relatively strong spring. This part too was shirked in all the earlier models, until I insisted on it in the Perth apparatus. I introduced several other improvements, which will doubtless be retained in all kymographs turned out by Teinturier. One defect of the Perth machine was that the inner point of suspension of the cylinder was too near the wall of the motor. It may not have made any practical difference, but one felt uncomfortable. Moreover, that system of conical mounting without further ado is not to my liking. It leads straight to the falling of the cylinder, with the slightest turn of the regulating screw. Some provision should be made for this : the axle of the cylinder should rest in ordinary bearings, *out of which it would be raised by the action of the screw*. It is no use talking nonsense about care : with that system the falling of the cylinder is certain, sooner or later, and, if the cylinder is bumped and jammed, what is the use of conical bearings and other hyper-refinements?

On the whole, then, the Teinturier machine is to be recommended, as far as workmanship is concerned, and it is beautifully finished. But a fly suffices to spoil the ointment. It is almost necessary to be in Paris, or have a friend supervising the construction, which is a slow business. (Our machine at Perth was ordered in May 1914, and reached us in August 1915.) A good plan, if feasible, would be to spend two successive vacations in Paris, seeing the machine started in the first, and coming back to fetch it personally during the second, a year afterwards. L'Abbé Rousselot very kindly offers to superintend the construction of such apparatus. His is the very highest possible authority, and his collaboration would have inestimable value. I have besides no doubt that he would really attend to the matter, if it were possible to get into touch with him by correspondence, but, as M. l'Abbé Rousselot's scientific work precludes much letter-writing, this is not quite so simple as it looks. As for ordering direct from the maker or his associates, I will recount my own experience, and leave the reader to judge. — I ordered the machine through M. Lioret,



who is personally a very delightful man, but who never makes a mistake through doing anything in too great a hurry. Half-a-year later or so, he wrote to say that work on the apparatus had begun. A year after the order, he advised me that it had actually started. So far good. The box did not take more than four or five months to reach Australia. But, when it *did* come, the worries began. First, there was an excessive bill to pay for freight: between £ 4 and £ 5; simply because M. Lioret had given the box to rascally shipping-agents, and later told me he had no intention of altering his methods. Then came the customs: they naturally knew nothing of phonetics, and such a concern had never been seen in Australia before. In the end, they let it pass free, on the production of the aforesaid photograph (Fig. 1), where the machine looks as if it were decked out for a fancy-dress ball, with accessories belonging to the Dictaphone. (Its true accessories were not available at the time.) However, the really serious matter was the condition of the kymograph itself. When taken out of its box, it would not stir, though wound to the top. The chariot had not even been securely tied, and one of its runners had snapped. The motor would not work at all: the axles had in some way got out of position. It took several days, and some ingenuity, to get it to turn. Lastly, the delicately-cut wheels with slanted teeth, which serve to communicate the force from the motor to the cylinder, had got jammed. Only one speed could be used, and even that involved the action of defective teeth. — Why bother us with these miserable details? Send the thing around to the local watchmaker, and that settles the matter. — I beg your pardon, that does not settle it. No local watchmaker is able to deal with such contingencies. He can certainly scrape away with his coarse file at the delicate teeth, but you can do that for yourself, and it will be a very different matter from the teeth, technically perfect in cut and polish, as they stood before the machine started. — The long and short of the matter is that you cannot safely order a Teinturier kymograph, unless you either have a reliable and intelligent friend in Paris, to superintend the packing, or can fetch the machine away yourself. — But how was the apparatus from Lioret packed? — It was placed in a zinc-lined box, some fibre was thrown in on the top, and a small, loose



frame was put in amongst the fibre, I cannot imagine for what purpose. It surrounded the machine certainly, but threatened to do it harm, rather than good. — When I later personally complained to M. Lioret, he had no other answer than that the packing had been done most carefully under his own eyes, and that he would never be able to do it any better. That is to say, there is no possible remedy. My present attitude is this : I think well of the apparatus; I admire its finish; I overlook the outrageous time it takes to construct and get off; I am willing to pay the very stiff price demanded for it and its accessories, as well as the exorbitant freight, and even the absurd packing charge; but, if the machine cannot be got to reach me in good condition, I «draw the line» and refuse point-blank to buy it. — And where can a kymograph be had, besides the places already mentioned? — I do not know for certain, as regards a phonetic kymograph, but the Cambridge Scientific Instrument Co is very well spoken of, and would probably be the English firm best equipped to construct such apparatus to order.

As for the smaller kymograph, which is needed for travelling about, or even for demonstrations in the lecture-room, Zimmermann makes the most suitable model, for £ 10. But it will bear a lot of improvement, and would need to receive it, before I would buy it. First of all, its speed *must* be increased : Dr. Gutzmann's method of acceleration by hand is pure moonshine, which would give disastrous results in practice. The other point is that the smoked bands must be satisfactory. We ordered some at Montpellier, and Zimmermann sent us — I cannot imagine why — bands of the palest cream colour. By rubbing them, it was possible to make them a faint shade whiter ( — they are made of snow-white *couché* paper — ), but only in the brightest daylight could the two shades be distinguished, and barely then. This is surely not *smoking* : anyhow, such bands are utterly useless in practice. (The figures in Zimmermann's catalogue show perfectly black hands : so there may have been some misunderstanding.)

We now come to a series of machines of American manufacture, and here we have no trouble : they are always properly packed and promptly despatched. There are also agencies for them in most towns, although these agents are not uncommonly among the big-



gest scamps that walk in two shoes.<sup>1</sup> There will be required two Edison phonographs : I would suggest the Standard model, with wooden Cygnet horn, and one of the more recent hornless models. A dictating machine is also needed. At Perth I had a Dictaphone, as seen in Fig. 2, which shows, grouped together, the meagre apparatus I there had at my disposal. The Dictaphone Co's agency

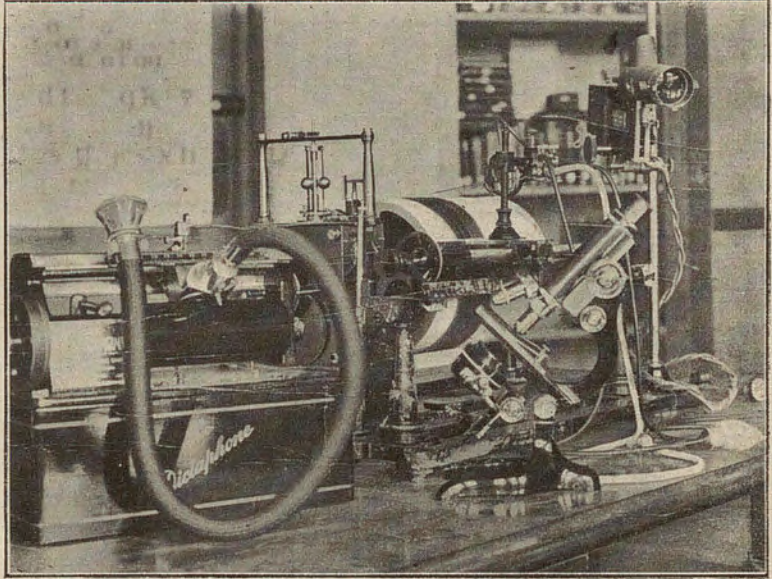


Fig. 2

in London sent me out a machine with a wretched diaphragm (— of course, as it was only for a laboratory), but otherwise perfect. The exquisite little electro-motor in the Dictaphone works ideally, the response to the pedal is almost instantaneous, and the apparatus is, in every way, mechanically flawless. I do not know, however, whether the Edison dictating phonograph is not an even

1. One of them once sent in a bill to a laboratory, in which I was a visitor, for a small spiral spring, with which to suspend the horn of a phonograph. The figure was 10/-. The spring was immediately afterwards examined by an expert, and valued at 2<sup>d</sup>, retail price.



better machine. It has no pedal, which at first seems a drawback : the stoppage is by means of a knob on the speaking-tube. I think the exertion for the finger or thumb is a trifle too great for the response to be absolutely instantaneous. But it might be replaced ( — I believe its action is pneumatic — ) by an electric connection, which could easily be contrived. I cannot say much more in favour of Edison diaphragms than of Dictaphone ones, as I have had to suffer and put up with such bad specimens of them. I suppose the impression in favour of the Edison instrument really depends on the blanks, which are incomparable. They could be used on the Dictaphone too, although I suppose this is prohibited. There are also some other dictating-machines, e. g. the Roneophone, but of these I have no experience. Be sure you buy a machine of American make : that is the golden rule. At least one shaving-apparatus will be wanted for these cylinder-machines. The Edison C<sup>o</sup> turns out a disgraceful model for about £ 2. I believe the Dictaphone C<sup>o</sup> charges £ 12 for a better class of instrument. In any case, you may count on its costing a tidy amount, if it is to be efficient. It should be run by an electro-motor, and the better types use a shaving-sapphire, instead of the unmanageable knife.

The next requirement is a Gramophone. The best type of His master's voice machine will not be too good for us. We will also have a second disc-machine : a Pathégraphie, from Pathé Frères (Paris). We have elsewhere said what we thought of the Pathéphone, or Pathé phonograph, and we now add that we have scant sympathy with the sapphire disc-machines, which are, in essence, an imposture, assuming the outward form of the Berliner gramophone, while really retaining the principle of the Edison phonograph. It need hardly be pointed out that they have barely a tithe of the power of the legitimate gramophone, as any one knows who has ever compared them. Still, as we are absolutely impartial, we will not refuse deserved recognition to the Pathégraphie, which, we begin by stating, is not a powerful instrument, but which has succeeded in producing some very good records, at least in French. It is difficult to form a definite opinion, without long experience, of the pedagogic value of the method, which consists in displaying, on a moving band, the text



that is being spoken, so that each word heard is, at the same time, exhibited to the eye. (By-the-bye, the mechanical action of the band might be just a trifle more perfect.) We have not got the faintest doubt as to the excellence of the printed band : that has come to stay, and have its use extended. It should have been put on the market ages ago. The point we are doubtful about is quite a different one,—viz., the feasibility and utility of repeating words after or along with the phonograph. Pauses appear to us indispensable, and that is the use we see in the Dictaphone. There it is really possible to stop after a word and rest, and even have the word repeated. If the phonograph is any use at all for language-teaching, the Dictaphone is the right form in which to use it. — To revert to the Pathégraphie, it will be found one of the most useful acquisitions of the laboratory. It is the instrument *par excellence* to show off to the «general knowledge» muffs, who come and waste your time with prying into what they will never understand. A turning concern that talks and writes simultaneously in a foreign language, of which they once had a vague smattering, appeals to their demagogic «common sense».

In order to turn to account the results of the recording machines, it will be necessary to have apparatus for converting their records into tracings. For phonograph cylinders we suggest the Lioretgraph, that being so heavily-made an apparatus that it does not require careful packing. Only, it *must* be improved. It *must* have a screw allowing it to take 4-minute records, and its stupid weight-motor and fly-wheel must be done away with. At Barcelona we adapted an electric motor to it, which did very well for transcribing, but the construction of the Lioretgraph must be modified, so as to work like an ordinary phonograph with an electro-motor. It will also be essential to get it to write in straight lines.

For the gramophone-curve transcription machine, I do not quite know what can be done. At least one was made in the United States for Scripture. Try an American firm, or M. Lioret, or the Cambridge Co. Personally, I should apply to M. Lioret, as the instrument is not unreasonably remote in principle from the Lioretgraph.

You will also require a Struycken apparatus, the latest fash-



ion in recording. It costs a latest fashion price, as you will find out, when you apply to M. Lioret, who is the maker. Yet it is an extremely simple affair, but delicate in some of its parts. I do not think it would be difficult to pack. Do not, in any case, allow yourself to be humbugged about the motor: no weight nonsense, and no charge of £ 20, or more, for a spring motor. It is bad enough to have to pay about £ 80 for a simple black box, containing nothing but spools on which to wind the sensitive paper. This very plain camera I should *a priori* have estimated at about 30/-. But the ways of phonetic instrument-makers are mysterious, and it is perhaps a mercy we do not fully comprehend them. I suppose the heliostat runs up the price of the Struycken toy. What the total amount is, I do not intend to tell. I believe it is somewhat elastic. Anyhow, you will find it the most expensive of all the instruments you have to buy, including the mammoth projection lantern.

You will next need microscopes. I would not suggest one for each table in the class-room, as I do not suppose you will ask any but the most advanced students to do microscopic work. Still, you will need a dozen, more or less, of various types. When microscopes are mentioned, the instruments of Zeiss (Jena) and Leitz (Wetzlar) are naturally thought of. Besides these standard makes, there are others hardly inferior. Some people have a preference for the microscopes of Himbler (Berlin), and I myself confess to a liking for the Reichert (Vienna) instruments, but I think that is only because we had one at Montpellier, which I used a good deal. At Perth, I had an excellent Leitz, as shown in Fig. 2. I believe that good substitutes can be had from the Bausch & Lomb Co, of Rochester, N. Y., and the microscopes of Koristka (Milan) are also very highly spoken of. I understand, from French scientists, that there are excellent English instruments, but that they cost a somewhat staggering price. I have no personal knowledge in this matter. — It is important to remark that the ordinary biological microscope is not really well adapted for our work. We do not require magnifications much above 50 or 80, which is nothing, but we *do* want an extensive field. Application to one or other of the optical firms mentioned above will bring specifications and designs of models specially



constructed, at very little extra expense. You will need rack-and-pinion object-holders, but the ordinary model (5 cm.) is too short : at least 10 cm. are required, and even that is not much. In order to be able to examine a whole sheet of tracings, a different type of apparatus is needed. The stage should carry a frame large enough to accommodate a whole kymograph sheet. The frame and the optical system must be displaceable in their relationship to each other, in order to allow of examining the sheet throughout its length and width. A microscope on this principle used to be supplied by Leitz, from the plans of Nebelthau. On somewhat different lines are the moving microscopes manufactured by Gurley of Troy, N.Y., and intended chiefly, I believe, for verifying inch-measures. If these were adopted, a good many modifications would be required. The first would be illumination of the sheet by transparency; then, longitudinal, as well as latitudinal, displacement of the microscope; next the fitting of a first-rate optical system, with fine adjustment and ocular micrometer, in substitution for the current one. A very handsome apparatus of this class is the macromicrometer (English makers : Adam Hilger, Ltd., London). The objection to it for our purposes (— not to mention its cost : some £ 80 —) is that displacement of the glass stage (— the microscope does not move —) in each direction is somewhat limited : 6 inches in the model with which I am acquainted.<sup>1</sup>

Another requirement would be a microscope on Boeke's principle, for examining phonograph grooves. — Most of these microscopes will be placed in the upper gallery : the Measurement room; but some will be kept downstairs : at least one good one in the Private room.

Sunlight is the best light for microscopes. It is easy to concentrate by means of flasks full of liquid. The best artificial light is the arc. There ought to be at least four Leitz Lilliput arc-lamps (or their substitutes) in the laboratory. These convenient little lamps also have another use, which is to project light

1. It may here be remarked that instruments of the type referred to in this paragraph, when supplied by firms that are not microscope specialists, are usually adequate only in the matter of the mechanical shifting devices, but deficient in regard to the optical parts.



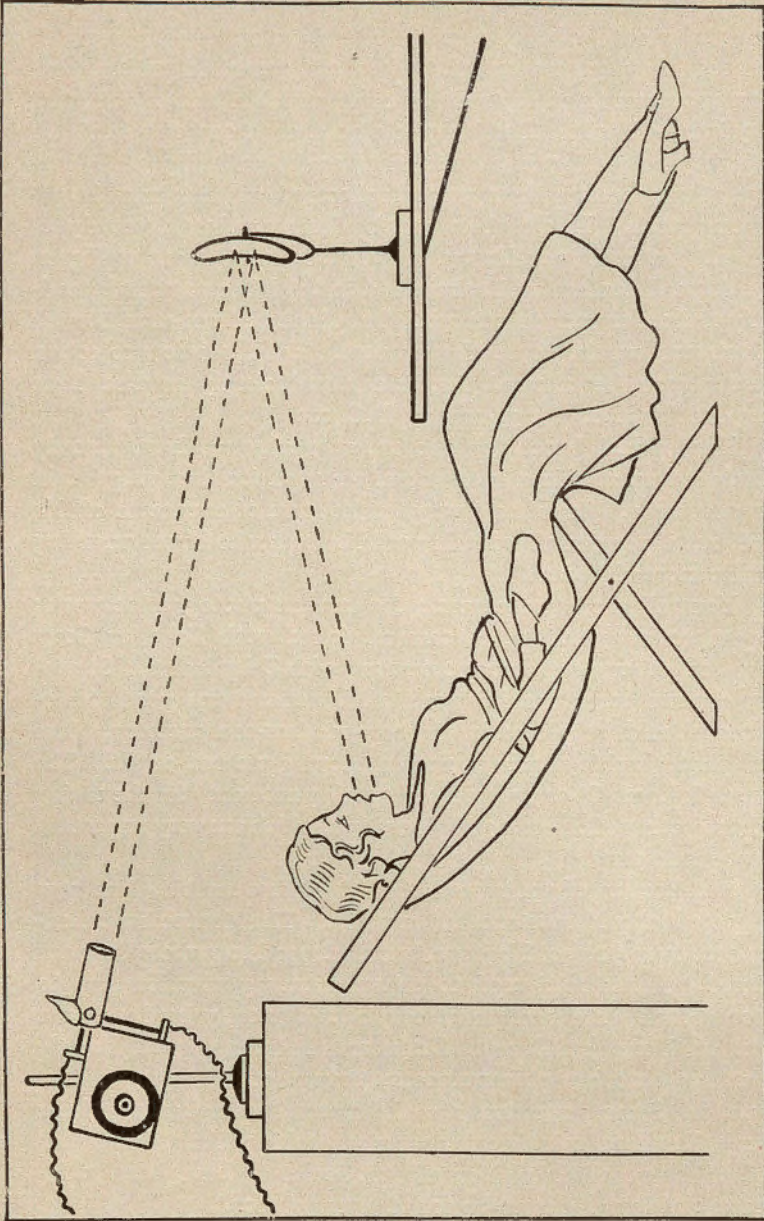


Fig. 3



into the mouth of any person under examination. For this purpose, they are unrivalled. They are furnished with a condensing system in an adjustable mount, which allows of obtaining a cylinder of light. The lamp is placed on a consol behind the patient, who reclines in a deck-chair, as shown in Fig. 3. A concave mirror receives the rays and reflects them back into the patient's mouth. This enables one, by little artifices, to study all the articulations, including *u*. My Perth lamp is seen in Fig. 2.

A small lantern will be required in the laboratory, independently of those already mentioned. One of the medium-sized Bausch balopticons would serve the purpose. Epidiastoscopic projection must always be allowed for, and a sufficiently intense light provided for it, i. e. a 35-ampere D.C. arc.

The optical bench for photomicrography we have already mentioned as standing in a room, reserved for that purpose, in the west wing. Zeiss has a very simple form of apparatus of this type, but, if you can afford it, it would be better to have something a trifle more elaborate.

You will need two cameras for current photographic work : one an ordinary half-plate camera, fitted with Zeiss or Goerz lenses; the other a stereoscopic camera, with Zeiss lenses. Stereoscopic views are of manifest use in Phonetics : two good stereoscopes should be placed in the bow-window-conservatory. The last photographic requirement is a moving-picture outfit. The Bausch & Lomb Co can provide everything necessary for the taking and projecting of cinematographic views, which are very important for phonetic purposes.

A collection of tuning-forks will be indispensable, but how complete it should be is another question. The Montpellier collection cost over £ 1,000, I believe, but all depends on where they are ordered. Montalbetti used to charge extravagant prices, up to £ 100 a fork. He had them constructed mostly by Landry, a pupil of Kœnig's (Paris). Zimmermann makes good electric forks, for chronographic purposes : several of this type will be required. Some resonators are the natural complement of the forks. The long cylindrical resonator, looking like a flute, that used to be supplied by Montalbetti, seems to have been a favourite : at least, it is to be found everywhere.



Despite the uncertainty of our present records, it will be as well to have several (say, three) Meyer logarithmic measurers. The principle of the apparatus is very ingenious, and, when we get regular kymographs, the results will be reliable. It would be highly advisable to replace the magnifying glass, supplied with the instrument, by a good microscope.

We will not dwell on all the smaller things needed to complete the outfit of the laboratory: they are very numerous. The organiser will use his own judgment in this matter, making out his list from the standard books. But we will put in a word for musical instruments, which are usually neglected.

Besides the grand pianoforte, it is desirable to have several good upright pianos. The wind instruments are particularly useful for recording purposes, both the brass and the woodwind. A violin, a viola, a cello are indispensable; and the percussion instruments are by no means to be despised: on the contrary, they will prove most helpful, in connection with the study of stress and lilt, whether in verse or in prose.

Granada, July 1917.

E. F. E. SUDDARD