born at Market Bosworth, August 20, 1710. He was brought up as a weaver, and the little learning he obtained as a boy was gained in spite of many disadvantages and obstacles. Indeed, the opposition he received from his father at last drove him from home, and he went to Nuneaton, where, at about the age of twenty, he married his landlady, a widow of fifty.

His acquaintance with mathematics began at the age of twenty-four with "Cocker's Arithmetic," the study of which he combined with that of astrology, his tutor being a fortune-telling pedlar. Simpson's astrology, however, brought him more trouble than credit, and on the charge of frightening a girl into fits by "raising the devil" he had to leave the district. He spent some time at Derby, and in 1735–6 he went to London, worked as a weaver in Spitalfields, and taught mathematics in his spare time. A year or two afterwards, with the sole assistance of Edmund Stone's translation of L'Hôpital's "Analyse des Infiniments Petits," Simpson wrote "A New Treatise on Fluxions," which was considered a notable contribution to the literature of that comparatively new subject. Other publications followed, his pupils increased, and he gained a considerable reputation.

In 1743, through the influence of William Jones, the mathematician, Simpson obtained a post as professor of mathematics at the Royal Military Academy, Woolwich, and two years later he was elected a Fellow of the Royal Society, having already been made a member of the Academy of Sciences, Stockholm. After holding his post at Woolwich for eight years he was seized with illness, caused, it was thought, by overwork. Advised to try his native air, he journeyed to Bosworth in February, 1761, and died there on May 14, in the fifty-first year of his age. He was buried in the churchyard of Sutton Cheney, a parish a short distance from Market Bosworth, where in 1790 the Leicestershire antiquarian John Throsby placed a tablet over his grave. Simpson had one son, who became a captain in the Royal Artillery, and one daughter. His wife survived him many years, received a pension from the Crown, and died in 1782 at the great age of 102.

Edgar C. Smith.

ELECTRICAL AND OTHER PROPERTIES OF SAND.[1]

THIS material, which flows so freely through my fingers and may be poured in the manner of a liquid from one vessel to another, is common sand. Specimens from various parts of the world are here exhibited; there are sands from the Sahara Desert, from New Zealand, France, Scotland, and several parts of England. There are also bottles of the coloured sands from Alum Bay, in the Isle of Wight, and Redhill. It may be pointed out at once that this coloration is merely due to the presence of an adherent layer of oxides or hydroxide of iron, for even varieties which appear under the microscope to contain little or no coloured particles generally have a trace of iron clinging to the grains.

For instance, a small quantity of white sand from Charlton, having been wetted with strong sulphuric acid before the lecture, will yield on the addition of water a solution containing iron. A few drops of ferrocyanide of potassium give a strong blue characteristic precipitate.

Fig. 1.

Further, the so-called black iron sand from New Zealand consists almost entirely of magnetite. If some of it is poured out upon a sheet of paper and brought near to a powerful magnet, you see that the grains fly eagerly to the poles and form large clusters there. This powder, on account of the regularity of its grains, their highly magnetic character and freedom from dust, is particularly useful in the laboratory for tracing lines of magnetic force. It is interesting to compare this with the black oolitic sand from Compton Bay, in the Isle of Wight, for that is a silicate of iron, and therefore non-magnetic.

I wish now to direct your attention to some of the phenomena connected with sand in large quantities, such as are met with upon wide stretches or drifts.

Blown sand, having been stopped by hedges and grass, gradually accumulates to a mound (Fig. 1)—in some cases with serious consequences. Dr. Vaughan Cornish, who has made a special study of this subject, has clearly proved,

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[1] Discourse delivered at the Royal Institution on Friday, February 11, by Mr. Charles E. S. Phillips.

however, that the formation of a sand dune is very frequently due to wind eddies. The second photograph was, in fact, taken by him in Egypt, and depicts the steady, irresistible march of millions of tons of sand, encroaching upon and slowly burying casuarina trees (Fig. 2).

To come nearer home, the seriousness of problems arising out of this state of things may be illustrated by two photographs obtained recently at Southport, in Lancashire. In the first one (Fig. 3), the back garden of a newly built house is nearly buried beneath the enormous hill, which will probably soon cover the whole property. The second (Fig. 4) shows that the familiar appearance of a sandy beach at low water, with regular lines of ripples, may be produced by the direct action of the wind, and, incidentally, the utter futility of constructing an esplanade in such a neighbourhood. All these phenomena depend, in some measure, upon the size, weight, and shape of the sand grains themselves.

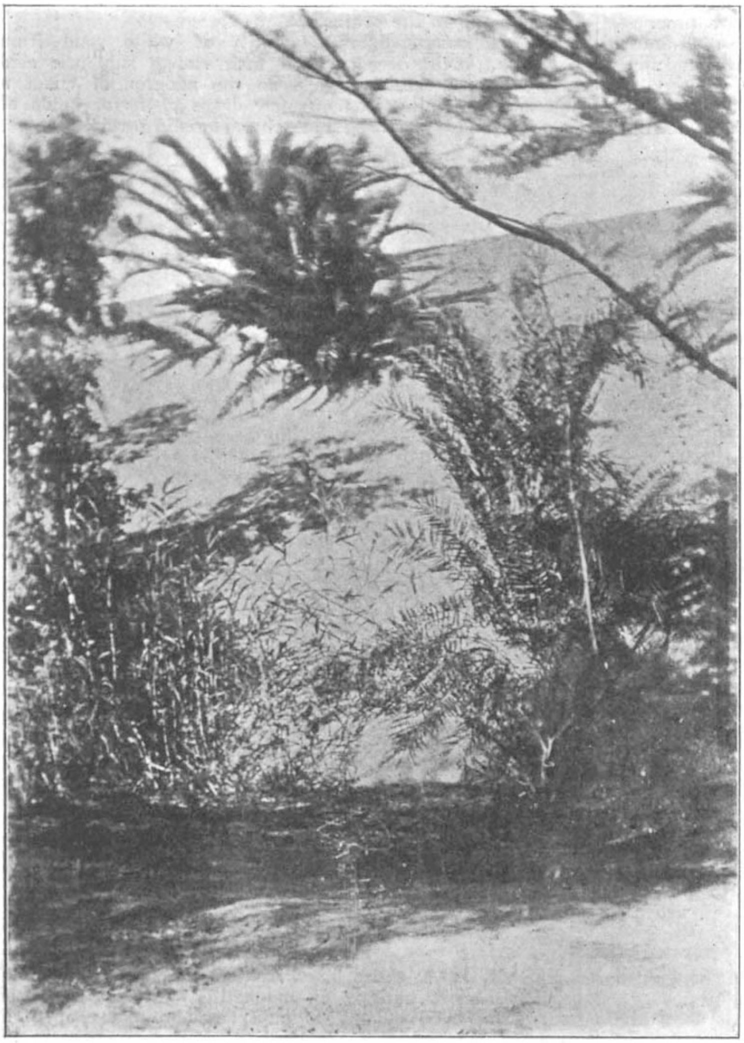

FIG. 2.

Silica, a substance which occurs in numerous impure forms, and constitutes a large portion of the rock masses known to geologists, is also to be found in a pure state as crystalline quartz. Here is an actual specimen about 18 inches long, which, together with the beautiful group of quartz crystals by its side, known as amethysts (and tinted, probably, by a trace of organic matter), are the property of this institution. Sand, therefore, being the result of rock disintegration, assisted by the grinding action due to the motion of wind or water, varies in composition in different localities.

The next slides are photomicrographs taken with a low-power objective. They represent some grains of sand found at Charlton and the Isle of Eigg respectively (Figs. 5 and 6). The former are seen to consist of minute silica particles of very irregular form, whereas the larger grains of the Eigg sand are remarkable for their smoothness. It is owing to this fact that the latter possess a peculiar property, to be referred to later.

Owing to the Sahara Desert having once formed the bed of a vast sea, it is, of course, found to be rich in marine deposit.

The damage which sand is capable of doing has been already referred to. It must not be forgotten, however, that its utility in the arts and crafts is of the utmost importance. The Egyptians are reputed to have been the first to find a wide use for it. They were probably the earliest glass-workers in the world. By the time glass-making was begun in England, viz. about 1611, the Romans and Venetians had so far mastered the art of blending sand with other substances that almost all the technical difficulties had already been overcome.

Now the melting point of silica being about 3000° C., it cannot be worked in an ordinary furnace. In glass-making the sand is therefore heated with a salt of one or more of the alkaline group of metals, preferably with sodium carbonate. At a moderate temperature sodium silicate is formed, and if this be subsequently heated in the presence of either lead oxide or borax, the melting point of the mass is still further reduced. Here is a white-hot crucible containing sand so treated and melted. You see the glass pours out like treacle, and sets rapidly into a transparent slab upon a hot brass plate.

Many useful applications, besides providing us with windows and glass-ware, have been found for sand, such as the decorating of hard surfaces by means of an impinging stream of its particles, scouring and cleaning, preventing slip on the roads, and so on. By no means the least important of these is its employment in war as a protection against bullets; a thickness of 20 inches of dry sand is proof against the modern rifle.

Now a mass of sand grains moving down a slope, by a motion consisting of rolling and sliding, meets with great opposition, due to friction. The grains thus come into close contact with the surface, and a considerable charge of electricity may readily be obtained by the simple device of allowing them to impinge upon a suitable substance.

A stream of sand flowing from the base of this reservoir B (Fig. 7) strikes upon an oblique sheet of tin T, which is attached to an insulating pillar N. An electrostatic voltmeter connected with the metal plate serves to measure the electrical potential. You see that in a moment the tin becomes charged to 3000 volts. The needle, however, soon falls back. Something has changed. The plate has, in fact, become dulled and pitted where the sand struck it. A fresh part reproduces the high potential. Filter paper is far more serviceable, and so is a wooden surface. One may rapidly obtain a potential of 6000 volts if the sand fall upon paper or wood, and this can be maintained for a considerable time. If the reading of the voltmeter diminishes, a fresh portion of the surface offered to the sand stream immediately brings it to its original value as before. The greater efficiency of paper (preferably filter paper) as compared with a metal sheet in producing the electrification, appears to arise in the following way.

A fine layer of dust soon becomes firmly imbedded in the metallic surface, so that further sand falling does not come into contact with the metal itself. On the other hand, it is probable that these particles cut through the fibres of the paper, and thus free themselves. I need hardly point out that the filter papers used should not be specially dried. Pieces which have been left about in a room for a few hours absorb sufficient moisture to ensure the right degree of conductivity.

The sign of the charge is always positive, in spite of the fact that a rod of silica rubbed upon the paper electrifies it negatively. In 1843 Faraday had noticed this curious reversal, and briefly refers to it in his experimental researches. Even if the actual silica rod be broken up into pieces, say as large as an orange-pip, and allowed to fall upon the paper held obliquely, the sign of the electrification is still positive. Further experiments have shown, however, that the sign of the electricity caused by friction against glass or silica depends upon the form of the rubbed surface. For instance, a strip of paper stroked by the smooth side of a tube of either substance becomes negatively electrified, whereas if the sharp edges of the end graze the paper, the sign of the electrification of the latter is positive. Now sand consists of sharply angular particles of silica, and even the comparatively large pieces obtained by crushing the tube, as previously described, have razor-like jagged edges. We should therefore expect, from the result of the experiments just mentioned, that when either sand grains or even large silica chips fall upon paper they will electrify it positively—and this is what actually occurs. Why an edge of glass should give an opposite charge to that produced by a flat surface when rubbed, say, with paper, is a question of great interest and difficulty. But that this is the explanation of the strange electrical behaviour of practically all powders appears certain.

The sand grains themselves become, of course, negatively electrified after striking the paper, so that this is often a convenient method of obtaining a high potential of either sign. Further, a stream of sand falling upon a metal plate will give a comparatively low potential, say 600 volts, for an indefinite period, in spite of pitting, and a tolerably steady value may be obtained by catching the grains upon a second disc (previously dulled by a sand-blast) connected with the apparatus required to be constantly electrified. As the charge increases upon this, a point is reached when some of the impinging sand particles become deviated by repulsion, so as to completely miss it. If the potential falls below the critical value, a reverse action takes place, and the plate rapidly charges up.

Turning for a moment to the question of the electrification produced in sand by the friction between the grains, experiments upon this point may be conveniently made by catching the particles, which roll down the surface of a sand cone, upon a small wet insulated table. Any electrification of the latter may then be detected in the usual manner. If the grains are all of the same nature, we should not expect to find other than slight irregular charges. The friction between particles differing in composition would give more definite results. Thus white sand racing over iron sand might be expected to show a charge; but experiment gave only a feeble electrification. I mention this because it is of interest in connection with the atmospheric electrical phenomena which often accompany sand storms in hot climates. Even if the wind electrified the surface of the sand over which it blows, the charge would probably leak instantly to earth, for in common with all powders it readily absorbs moisture into the interstices between the grains. When making electrical experiments with this material, it is therefore essential to have it well warmed.

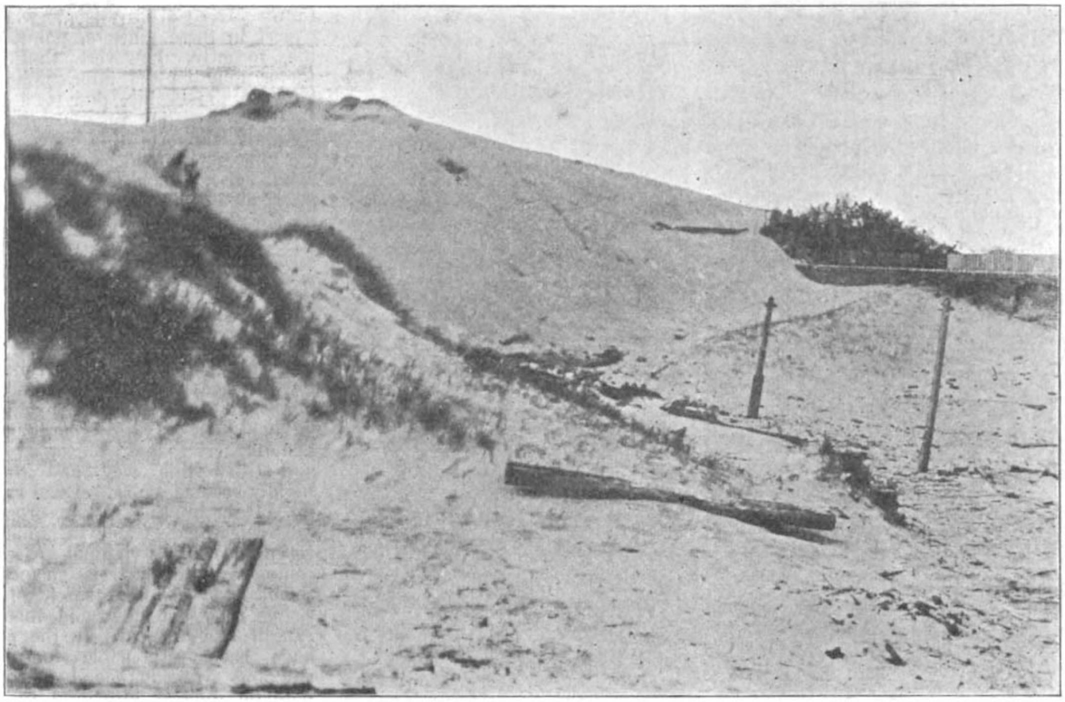

FIG. 3.

There is still much useful work to be done in studying the electrical conditions in the neighbourhood of wide stretches of warm sand swept by dry wind. Owing to lack of data, it is difficult to form an opinion as to the part which this substance plays in the remarkable electrical phenomena sometimes witnessed during a storm.

I spoke of allowing sand to run down itself. Here is a cell made by separating two glass plates, 14 inches square, by strips of wood along the bottom and top edges. The sides are open. Through a hole in the upper distance strip sand pours from a funnel, and builds itself into a beautifully symmetrical conic section. Presently the base will so far widen that any further increase shoots the sand off through the open ends of the cell. When this point is reached the cone can no longer grow. A supply of white sand is then poured in, and seen to run down the sloping sides without carrying any of the coloured particles with it. The base has spread out proportionately as the cone increased in height, so that the angle which the sides make with the horizontal shall be 35°. If the sand be wet or damp, this law no longer holds. The addition of sufficient water materially diminishes the friction between the grains.

It is often observed when walking along the sea-shore, upon sand left wet by the receding tide, that for a moment the foot, on touching the ground, is surrounded by a comparatively dry area. This appearance is quickly followed, however, by one which indicates that the sand has gathered moisture, for on lifting the foot—which has by now probably sunk a little below the surface—the excess of water is particularly noticeable. In order to explain this we must have recourse to some ingenious experiments made a few years ago by Prof. Osborne Reynolds. He pointed out that a number of particles, whether spheres or irregular grains, may fit together in such a way that the size of the spaces enclosed by them is either a maximum or minimum. Figs. 8 and 9 show a sectional view of a collection of spheres, arranged in what Prof. Reynolds calls abnormal and normal piling respectively. It is evident that the spaces between the spheres are far less in the second than in the first case. Now here is an elastic bag tied upon one end of a glass tube. The arrangement is partly filled with sand and coloured water—the latter standing 2 inches in the tube, so as to serve as an index. If the bag is now tapped, all the particles in it become normally piled. We have seen that any departure from this arrangement will enlarge the spaces between them. It is no longer surprising to notice, therefore, when the bag is pinched and the grains are thus made to ride up on one another, that the liquid in the tube, instead of rising, actually sinks.

Fig. 4.

Returning to the effect observed upon the sea-shore, we see that the pressure of the foot disturbs the arrangement of the sand-particles from one of normal piling to one in which the interstices between the grains become larger. Since these spaces were originally full of water (held up by capillarity), they are now no longer filled, and we obtain a comparatively dry area. Water is rapidly drawn in from all sides, however, by the partial vacuum formed in the interstices, and the internal friction diminishes. The sand feels insecure. On withdrawing the foot normal piling is resumed, the excess of water producing a puddle, until it slowly percolates away whence it came.

This brings me to the subject of quicksands.

A certain amount of unnecessary mystery seems to surround this matter. I hasten to point out that the grains of quicksands appear to be in no way extraordinary. Nevertheless, the fact remains that sand in certain localities upon the coast readily gives way under a load. Instances are recorded where a cart driven over a wet shore has rapidly disappeared below the surface. The general opinion seems to be that this is due to a soft underlying layer of clay or mud, which no doubt in some instances is the true explanation. Mr. Carus-Wilson, who is an expert in these matters, pointed out to me recently, however, that another factor may be the imprisoning of gas between the grains, due to decomposition of organic matter. Experiment certainly supports this view, for you see that one of these beakers of wet sand easily sustains a weight which sinks down in the other. Yet both appear similar. The sand in the second beaker, however, was mixed when dry with a powder capable of effervescing if wetted. In the neighbourhood of dangerous bogs, in Ireland especially, it is evident that a quantity of gas is imprisoned in the mud.

It must also be borne in mind that any surface in so good a contact with wet sand that the air is excluded will be held fast by atmospheric pressure; and further, that an object so situated, and tilted this way and that, will rapidly become embedded and swallowed up. It is by this simple process that the celebrated Goodwin Sands have claimed so many victims. A large percentage of the vessels stranded upon them, however, float safely off on the rising tide, but now and then one is caught and doomed. In the past they have been responsible for many a shipping tragedy; and there is a pathetic interest attaching to the fact that ribs and other remains of ships, long lost and forgotten, sometimes reappear for a time above the surface. Since the advent of steam, it is happily a rare occurrence for a vessel to be lost upon a sandbank.

In 1849 boring operations were carried out on the Goodwins by the engineering staff of Trinity House. The Deputy Master and Brethren, whose generous offer of assistance on all matters relating to this subject I gratefully acknowledge, have kindly lent a model made at the time, which shows the nature of the sand found at increasing depths. Solid chalk was reached at 80 feet below the surface.

Let us now turn to some experiments upon the flow of sand through a tube. This long glass barrel is filled and ready. I free the nozzle, and collect the powder which flows out during ten seconds. The quantity so obtained is placed in one pan of a balance. When the height of sand in the tube has fallen to only a few inches above the outlet, I repeat the operation, placing the second amount collected in the opposite one. You see that the pans again stand level. It is therefore clear that the sand pours out at the same rate, irrespective of its height in the tube.

The question now is, how has the "head" been so completely destroyed? This may be answered by a further experiment.

A glass cell 2 feet high, 14 inches wide, and ½ inch deep, is closed in at the sides only (Fig. 10). A movable section of a cone O, made of wood and imitating one of sand, is pushed up through the lower opening. Resting upon this, and fitting its sloping sides, is a strip of felt D. If the wood section be lowered (as shown in the figure), the felt, resembling an inverted V, remains wedged between the glass back and front of the cell. A very small force, however, will dislodge it.

Suppose we replace the wood model and hold it in position by a strut S. Regarding this as a section of a sand cone, we see that its entire weight would be carried upon the base of the cell. Sand is now poured in from the centre of the top opening, and rests upon the sloping felt. The point to notice is that it supports its own weight. When the particles are interlocked it resembles the span of an arch, for if I now remove the wood section the sand remains in position. When more is added, and the cell is nearly filled, the net weight is considerable, yet the felt bridge is not deformed in the least. Further, a wooden plunger P, fitting the top opening, and carrying heavy weights, may be inserted without increasing the pressure upon the felt.

Since the angle which the slope of a dry sand-cone makes with the horizontal is 35°, the height, h, to which the particles will build in a tube of radius r, so that the base of the cone corresponds to the diameter of the tube, is $h = r \tan 35°$. If we consider an element of the section just referred to, it is evident that a vertical downward force applied to the top of the sand becomes resolved in two directions, making an angle of 55° with the vertical. Now, applying the well-known formula for a symmetrical triangular frame loaded at its apex, we have

$$H = \frac{Wl}{4h} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where H is the horizontal thrust, W the load, l the span, and h the height.

Regarding the cell as the section of a tube, $l = 2r$ and $h = r \tan 35°$. Therefore, substituting these values in (1), we have

$$H = \frac{W}{2 \tan 35°} = \frac{W}{1 \cdot 1}.$$

The ratio of the force applied vertically to that of the lateral thrust is thus equal to twice the tangent of the angle which the slope of a cone makes with the horizontal, viz. 1·4.

For instance, if the vertical force due to a weight placed on the sand is 100 lb., the lateral pressure will amount to about 71 lb. A piston resting upon a column of sand only a few diameters high, contained in a strong tube closed at its lower end by merely a thin membrane, is capable, therefore, of sustaining very heavy loads.

In order to demonstrate this on a moderate scale, I have arranged a sort of gallows, through the projecting arm of which a flanged brass tube is inserted vertically. This tube is 0·5 inch in diameter, and closed at its lower extremity with a piece of cigarette paper held in position by an indiarubber band. A small quantity of sand is tipped into the tube from above—enough to fill it to a height of 3 inches. The column within will therefore measure 6 diameters. The tube is then well tapped to ensure normal piling of the grains, and a loosely fitting iron plunger is inserted so as to rest upon the sand. Attached to the plunger is a cross-piece carrying a ring at each end, which may be grasped with the hands. My assistant (who weighs about 11 stone) thus suspends himself safely, his weight being supported by the small sand column. If the piece of cigarette paper is now removed, he is let down with an unpleasant jerk.

Some idea of the close arrangement of the particles may be gathered by noticing that a long column of sand, moving downward within such a tube, will produce a vacuum above it sufficient to lift water to a height of about 6 feet. (Experimentally shown.)

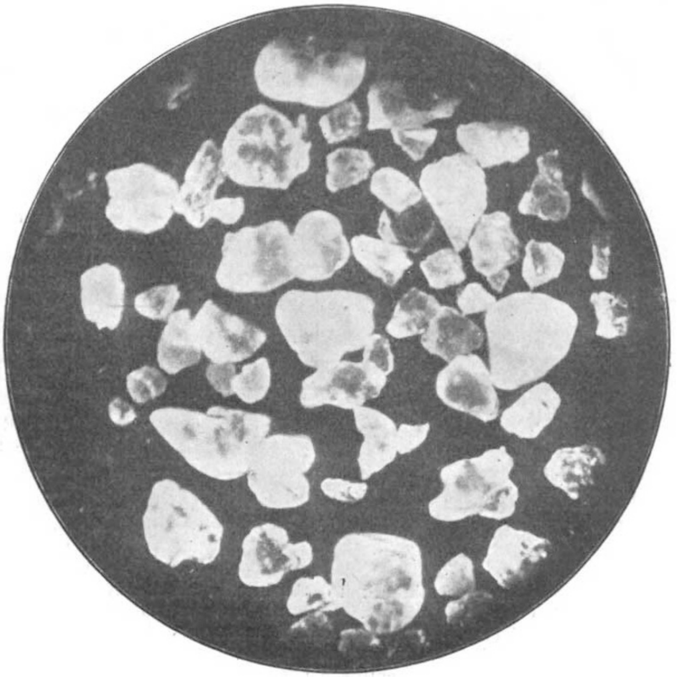

FIG. 5.

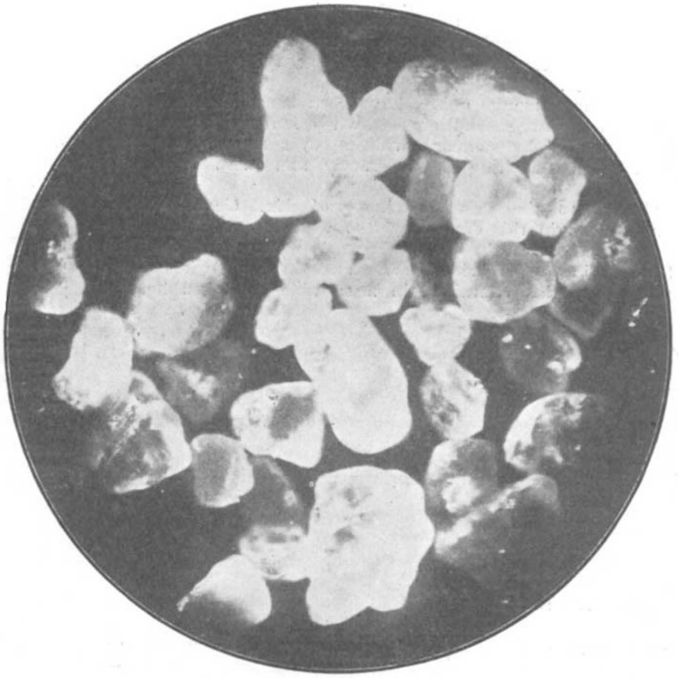

FIG. 6.

These experiments upon loaded sand columns clearly prove, therefore, how it is that the "head" is destroyed, and explain why the powder issues from an orifice at a uniform rate.

Lord Rayleigh applied this principle to a very interesting device, which he used here some years ago, for the purpose of slowly rotating a smoked disc. A weight stood upon a sand column contained in a glass tube. Its downward motion as the column lowered, due to escape of powder from a nozzle at the end, served to operate a train of wheels. The question arises, however, as to whether such a motion is quite uniform. In other words, does the sand move regularly in the tube? Experiments indicate that it is very difficult to obtain an absolutely uniform motion by this means. Friction appears to be the controlling factor. A tube, oiled upon its inner surface, is now filled. On freeing the nozzle, you see that the sand moves out by slow regular jerks. Certain curious rattling sounds, emitted occasionally by the column descending in a glass tube, also drew attention to the intermittent motion of the grains.

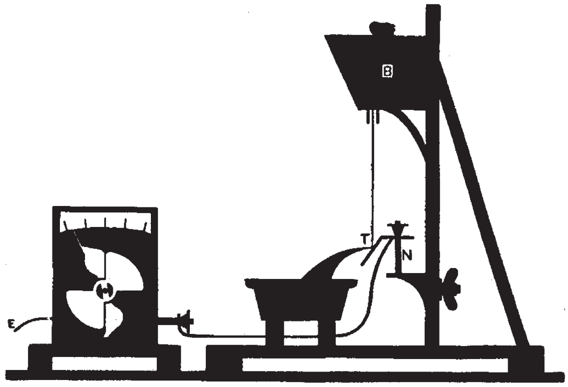

FIG. 7.

It seemed reasonable to hope, therefore, that this might be made sufficiently rapid and regular to give rise to a musical note.

Now many strange noises have been heard in the neighbourhood of large sand masses when surface layers have been disturbed by someone walking over them; and there are curious shrieking sands—rarely met with upon the coast.

Thanks to the great kindness of Mr. Carus-Wilson, whose work in this direction is so well known, I am able to exhibit a remarkable specimen of sand from the Isle of Eigg, in the Hebrides. When a plunger strikes down upon the grains contained in a suitable cup, you hear a piercing musical sound. Mr. Carus-Wilson attributes this to the friction between the particles, the effect being produced in much the same manner as that which results from gently rubbing an agate style upon glass. He has discovered musical sand in Poole Harbour, as well as at other places.

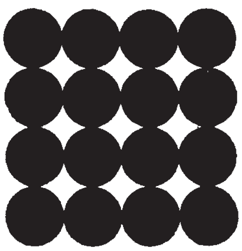

FIG. 8.—Abnormal Piling.

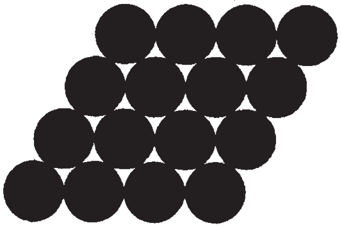

FIG. 9.—Normal Piling.

The essential conditions for the production of this sound are:—

(1) That the grains be nearly of the same size and rounded.

(2) That they be clean and free from adherent fine dust.

(3) That the vessel in which they are struck have sloping sides, and be made of a suitable material.

But to return to the question of obtaining musical sounds from ordinary sand.

There stands, fixed to the wall, a large glass-fronted section of a tube. It is filled with alternate bands of white and black sand, the latter being about one-sixth as deep as the former. An outlet is provided at the bottom. This arrangement enables the motion of the different portions of the sand column to be observed while the powder issues from the orifice.

On freeing the nozzle, we see that the centre of the lowest black band immediately falls, and that, as the sand continues to escape, successive bands become similarly deformed. It is clear that the grains from the central part of the column are moving rapidly downward, and, since no eddies can form in the remainder, the whole becomes divided into a core of moving particles and a large surrounding mass of dead sand (Fig. 11).

The diminished density of the axial region releases the lateral pressure upon the sides of the tube, and the upper part of the column suddenly slips until the grains again pack and seize as before.

Now if sand of a suitable fineness be slowly passed in this manner through a glass tube of correct dimensions, a musical note may be produced.

The tube should be about 1 inch in diameter, and filled with sand resembling that found in the Charlton pits. The length of the one now ready is 3 feet. When the flow begins, a curious rattling sound is heard, which finally changes to a distinct musical note. It may be varied slightly, say to the extent of a whole tone or so, by gripping a part of the tube while the sand pours out. The two upper dark bands (Fig. 11) have not become deformed, except slightly at their ends, owing to friction between the sand and tube. It is essential for the production of musical sounds that the ratio of the length of a column to its diameter be such that the upper portion moves downward without central deformation. In order to explain the cause of the sound, we must therefore consider the motion of this more or less compact body of particles.

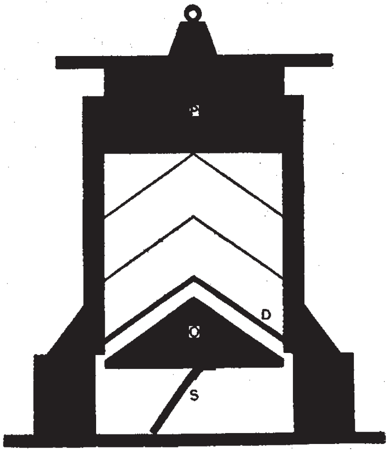

FIG. 10.

Now, if the lower half of the tube be filled with mercury and the rest with well-packed sand, the regular lowering of the liquid causes the granular piston apparently to stretch until its extension is about 2 per cent. of its original length. It is not until that point is reached that the upper layers begin to move downward. The particles, however, are no longer normally piled. A further slight movement of the lower layers causes the upper ones to follow and to overrun a little (owing to their momentum). Therefore, even if the mercury is adjusted to pour out uniformly from the orifice, the upper part of the sand column moves downward with an intermittent motion, analogous, in fact, to that of a weight drawn over a rough surface by an elastic string. It is also clear that, within wide limits, the motion of the upper layers may be independent of, or completely out of phase with, that of the lower ones, and still produce a musical note.

The glass wall of the tube is thrown into violent vibration by the intermittent rise and fall of the lateral pressure upon it, so that damping the barrel raises the pitch of the note. The greater part of the sound is due, however, to the direct action of the sand column upon the air above it, for even a tight wrapping of tape but slightly affects its quality. Where the tube is filled entirely with sand, the pitch of the note emitted rises as the column diminishes, owing to a proportional decrease of inertia.

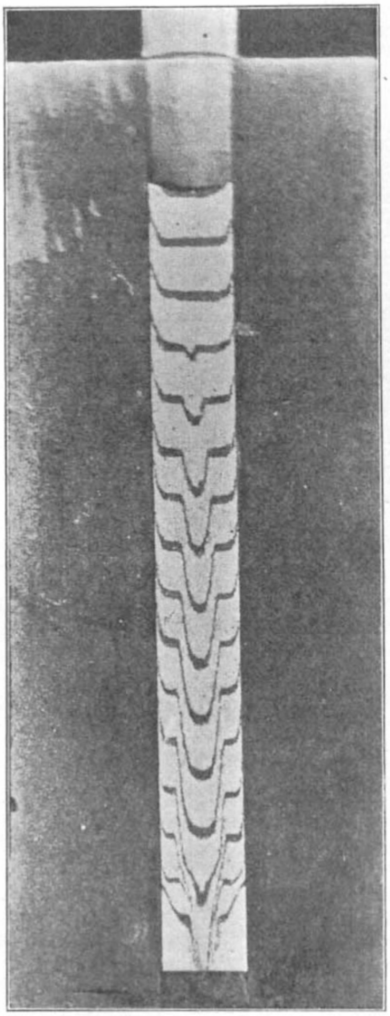

FIG. 11.

In order to see in what way varying the friction between the grains would influence the result, we may fill the tube with magnetic sand and magnetise the column longitudinally. This can be conveniently done by winding a current-carrying wire round the tube. With such an arrangement, the sound produced by the descending column, though feeble at first, is strongly increased on magnetising the grains. Each time the circuit is "made," the sound, almost inaudible before, is plainly heard. In all cases the closeness of the grains, *i.e.* the proportion of normally piled particles, largely determines the pitch of the note. Other factors are the state of the glass surface, the size and roughness of the grains, as well as the rate at which they issue from the nozzle. By suitably adjusting all these conditions, a limited number of notes may be obtained. So far, I have succeeded in producing only five with any degree of certainty, one note being, in fact, obtained by damping the vibrations of the largest tube. The sound is hardly pleasant, but nevertheless I venture to play, if I can, a simple tune upon what may perhaps be called the sand-organ.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. B. C. A. WINDLE, president of Cork University College, has announced that Miss Belle Henan is prepared to place at the disposal of the college at once a sum of 10,000*l.* for the foundation of scholarships to be named the Henan Scholarships.

THE September number of *School Hygiene*, ready on September 1, is a special congress number containing a full descriptive account of the third International Congress on School Hygiene held in Paris on August 2–7. The inaugural speech of the president, Dr. Mathieu, is given in full, as are also the address to the congress by Dr. J. Kerr, chief school medical officer to the London County Council, "The Doctor's Work in the Schools," and by Dr. Chotzen, of Breslau, "Instruction on Sex." Descriptive accounts of the proceedings in the eleven sections, a notice of the exhibition, a special report of the gymnastic and dancing displays by the English and Continental classes, make up a very complete account of the congress.

THE organisation and coordination of educational effort are, we are glad to know, receiving the attention of the Board of Education. There are in many places several institutions competing with one another in their endeavours to attract large numbers of students in their classes, instead of each institution being assigned a definite place and work in an organic scheme for the educational advancement of the district. In connection with technical education, for instance, we have courses in university colleges, technical institutions, evening and similar schools; and to obtain a clear idea of the number and educational standing of students receiving instruction in pure and applied science in our State-aided institutions is almost impossible. The recent report on university colleges, of which a long abstract appeared in these columns, was a great advance upon any previous report, yet the tables published in it did not show the number of students in the various faculties, so no facts could be obtained from them as to the number of students in the country receiving relatively advanced instruction in scientific or engineering subjects. The volume of statistical information published by the Board of Education shows the number of students in technical schools and classes, but as much of the work thus carried on is of a very elementary character, the numbers give little indication of the actual progress of technical education in its true sense. In the "Regulations for Technical Schools, Schools of Art, and other Forms of Provision of Further Education in England and Wales," just issued by the Board of Education (Cd. 5329), Sir Robert Morant states that the Board hopes to issue, before the end of this year, a body of new regulations which will make more adequate provision for the coordination of continuation schools (day and evening), the grouping of subjects into organised courses, and the coordination of grants to institutions of university rank. At present these institutions receive grants from the Treasury and also from the Board of Education, whereas in an organised educational system one department of State should be sufficient to allocate their grants-in-aid. Separate regulations will be arranged to simplify the present plan; and it is hoped that the requirements which the Board will lay down to be satisfied by the institutions concerned will be such that they can be secured "without interfering with the freedom of universities to work out their curricula in the ways best suited to their individual needs."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 16.—M. Bouchard in the chair.—J. **Guillaume**: Observations of Metcalf's comet, made with the bent equatorial at the Observatory of Lyons. Two sets of observations were taken on August 11. The comet was about of the eleventh magnitude, and appeared to be of a bluish tint. The head was about 30″ in size, with a central condensation.—M. **Coggia**: Observations of the comet 1910*d* (Metcalf, August 9, 1910), made at the Observatory of Marseilles with the Eichens 26-cm. equatorial. Positions of the comet and comparison stars are given for August 11 and 12.—M. **Borrelly**: Observations of Metcalf's comet, 1910*d*, made at the Observatory of Marseilles with the comet finder. Data given for August 11 and 12. The comet is described as being of the eleventh magnitude, and as having neither nucleus nor tail.—J. **Chatelu**: Observations of Metcalf's comet made at the Observatory of Paris with the 30·5-cm. equatorial. Data given for August 11, 13, and 14. Magnitude about 10·5. The nebulosity surrounding the nucleus appears to measure about 45″ of arc.—R. **Bourgeois**: The daily movement of the top of the Eiffel Tower. The motion is due to the unequal heating of the four pillars, and varies between 3 cm. and 17 cm. In spite of the recent floods in Paris, the mean position of the summit has not changed since 1908. The direction of the motion appears to change with the season of the year.—Louis **Wertenstein**: Radio-