THE PEARL FISHERY OF CEYLON.

AN INDUSTRY OVER 3,000 YEARS OLD.

BY OUR ENGLISH CORRESPONDENT.

Oriental pearls have always been regarded as of the finest and most brilliant jewels, and have always occupied a high position, the demand far exceeding the supply. The greater part, and the most highly prized, come from Ceylon. The pearl fishery is one of the oldest industries in the world. Scientific methods have not until recently entered into its development. For over three thousand years, the pearl oyster harvest has remained in the hands of the natives, whose skill in diving has been handed down from one generation to another; and despite the great advances that have been made in the art, their primitive methods are still efficient, economical, and productive. In next week's SCIENTIFIC AMERICAN we will publish a description of a machine for digging oysters, which will probably be able to perform much more efficiently the work of the natives.

For years the fishery constituted a government monopoly yielding a handsome revenue, but three years ago it leased the work to a private enterprise for the sum of $125,000 per annum. The government was probably prompted to adopt this course from the speculative character of the undertaking. Whereas formerly a bumper harvest was secured one year, realizing possibly over a million dollars, several years of barrenness followed so that the average income became comparatively small.

The fishery is jealously guarded, the season is carefully regulated by ordinances, and the oyster beds are kept under constant surveillance to prevent illegal fishing or deterioration. On the average the season lasts about a month and provides occupation for over 45,000 people. The scene of operations is the estuary of the River Modragam in the Gulf of Manaar on the northwest coast. Here the banks or beds known as "paars" are peculiarly adapted to the raising of the bivalve which thrives abundantly. The bed is a stretch of shallow water varying from 18 to 60 feet in depth and stretching 50 miles along the coast and about 20 miles out to sea. The sea bed here is clean, hard sand offering but slight clinging security to the oysters in inclement weather. Indeed, oyster propagation is extremely dependable upon the weather. For instance, a survey showed that over one hundred thousand million young were clinging to one bank, but the facilities for their adhering were so slight that a second inspection a few weeks later found that the greater part had been swept away either by currents or the monsoon, and irretrievably lost. Under such circumstances the industry is one purely of chance.

The natural deficiencies in the sea bed must be supplemented by artificial remedies, so that the oyster spat may secure a firm hold against the severest weather. To this end the marine biological scientist Prof. Herdman, D. Sc., F. R. S., is engaged in scientific investigations to improve the conditions. In order to encourage the growth of the pearl-yielding cestode it is only possible to use certain materials for depositing or "cultching" upon the bank, to which they may adhere. The most suitable media have been found to be clean broken tiles and bricks, but as these are very difficult to obtain, experiments were made with native refuse by Prof. Herdman, but it was found to possess insufficient gravity to secure a desired deposit upon the sandy sea-bottom, and was easily and quickly swept away. The best results are now obtained from a calcareous cultch consisting of old broken bleached corals and dead shells from a beach. Prof. Herdman also advocates the utilization of the dead oyster shells themselves for this purpose. The "cultching" of the oyster beds is being carried out upon these lines. The material has the advantage of being readily obtainable in almost inexhaustible quantities at very little cost. The area to be covered by a first installment of cultching is twenty-five square miles, upon which thousands of tons of cultch have to be dumped. The monsoons prevent this work from the middle of May to the middle of October.

Four or five months before the season commences the banks are inspected to determine whether there shall be a fishery, and to estimate the extent of the yield. This has revealed the presence of over 400,000,000 young oysters upon the Periya Paar Karai, which is a continuation of the famous Periya Paar itself, from which the greatest yields of cestodes have been gathered during the past 3,000 years. This small sized, profitable, and reliable bank lies at a depth of from 50 to 54 feet and about the limit of the capabilities of the native diver, and probably for this reason it has not received the attention in the past that its yield would suggest.

The company also first exploited the banks known as the Dutch Modragam, Karativu, and Allanturai areas. They had previously proved so poor that they became neglected. They were inspected in 1904, but were found of no value. A second survey was undertaken with the result that a fishery was effected that year which otherwise would have proved barren. It netted the Ceylon government $300,000. In 1907 these banks yielded a gross revenue of $350,000.

The fishery is generally carried out in March or April. A short time before this a final survey is made and samples of oysters are tested for their yield. If satisfactory, the news is announced that a fishery will be held. It spreads like wild-fire not only through Ceylon itself but the whole of India, Malay, and up to the Persian Gulf, and the natives in these districts hurry to the island. A shanty town springs up at Marichchukkadi at the mouth of the Modragam River. It is inaccessible, practically vacant, and neglected, but in the season it is the hub of excitement. Streets of primitive dwellings fashioned of bamboo poles with a roof of palm leaves spring up, to accommodate some 45,000 natives, relieved by one or two bungalows in which agents and officials reside. The sea-front becomes crowded with a fleet of boats, some crazy and fragile, others large, roomy, and stoutly built, drawn up in one long line at anchor. Under government control no limit was placed upon the number of vessels, but now severe restrictions are imposed in order to curtail undue competition.

At this time the weather is most propitious. The sea is calm, especially during the day. Everything is carried out in methodical manner according to a strict schedule. A signal gun is fired about midnight and directly a frightful din arises from the raucous banging of tom-toms and other weird and discordant instruments beating the boat crews and divers to quarters. The keenest excitement prevails as some 300 boats strive to first reach the oyster paars.

Each boat carries native divers attired in a crude loin cloth. The diver closes his nostrils with a piece of horn and equipped with a net bag in which he gathers his oysters he drops over the side and quickly slides down a rope to the bed. When his bag is full he gives a sharp tug of a line and is quickly hauled to the surface where he discharges his haul and redescends. These men can remain under water from one to one and a half minutes, and they seldom come to the surface without a full load. The oysters are placed in bags, averaged to a common size, and sealed by an officer.

A careful watch is kept on shore upon the weather, and directly the wind changes the signal is given and immediately the fleet sets sail and races home. The return of the fleet is one of the most picturesque sights in the Orient, as the accompanying illustration shows. A considerable trade was formerly transacted in pilfered gems, but owing to the stringent precautions adopted now, and the continual presence of an official on board, this traffic has practically been suppressed.

After landing, the sacks of oysters are borne off to the *kottu*, or official inclosures, where they are stored until their disposal by auction. The diver is rewarded by being given a third of his catch. As the oysters may or may not possess valuable contents he invariably disposes of them in small lots to humble speculators, who trust to luck that they may net a crop of gems.

At the auctions bids are made for oysters held in bags. Formerly bids were for parcels of 1,000, which practice involved laborious counting. The purchaser transports the load to his quarters, where if he is only a small dealer he will open them himself, but if a capitalist will hand them over to his staff. Oyster opening and searching are carried out in every part of the town and the place becomes littered with shells.

The pearls are taken to merchants whose purchases will often aggregate tens of thousands of dollars. The gems are bought by weight determined in sensitive scales with seeds used as weights. They buy and transact sales as well. The stones are bought according to their luster, fineness, and size. In addition to these merchants there are many who transact business in a small way, while the huckster is always present cutting, drilling, and mounting pearls with the most primitive tools. Auction purchasers upon an extensive scale employ natives to open the bivalves and extract their contents, which are emptied into long vats, where they are sluiced by natives seated on the outer side of the vessels, who merely agitate the water and scour the oysters with their hands. Here again constant vigilance has to be exercised to prevent purloining of gems. Despite the care observed it is always possible for small pearls to escape into the refuse. Even this is carefully examined subsequently, as well as the oyster dried dust by being sifted through the hands.

The monopoly is required to expend a minimum of $1,000,000 upon improvements. It realized that inspection should be carried out for ascertaining whether virgin banks existed beyond the known area. This has been partially brought about by the exhaustion of the two great fishing areas which have yielded practically the whole of the pearls found during the past 100 years. That probably there are several unknown banks is borne out by the discovery of a new paar by Prof. Herdman holding some 5,000,000 five-year-old oysters rich in pearl. In some areas the conditions are so propitious to the growth of the cestode that the spat has a severe struggle for existence. Where myriads of young bivalves appear at fairly regular intervals but never reach maturity, it has been suggested that the spat should be transplanted to more favorable areas, but here a difficult obstacle has to be overcome, since it entails the handling of millions of oysters, and in a good fishery the garnering of 100,000,000.

Searching for pearls in dry oyster dust at the fishery.

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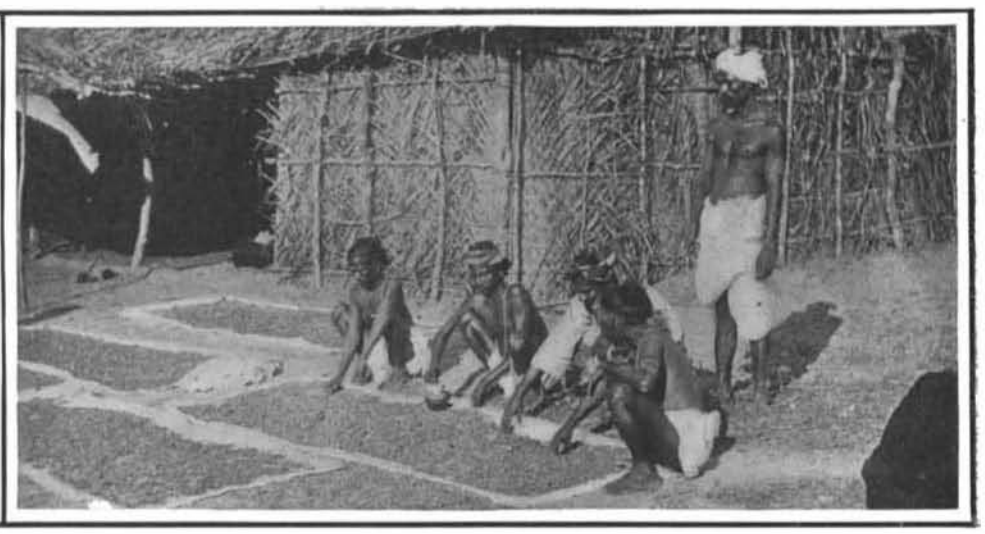
In 1907, 9,000,000 of spat were moved from a rich to an impoverished bank, but it was a mere dip in the bucket. What is required is some method of economically handling the young upon an enormous scale. Dredging has been found unsuitable since it disturbs and churns up the sea-bed where the spat is lying, so that a considerable amount is destroyed. The pearl banks, it may be pointed out, are merely sand-banks formed of sandstone and concretions upon which isolated masses of coral grow without forming reefs, so that severe disturbance of the oyster bed may very easily be set up. It is found that the collection of the spat by native divers is slow but the most satisfactory.

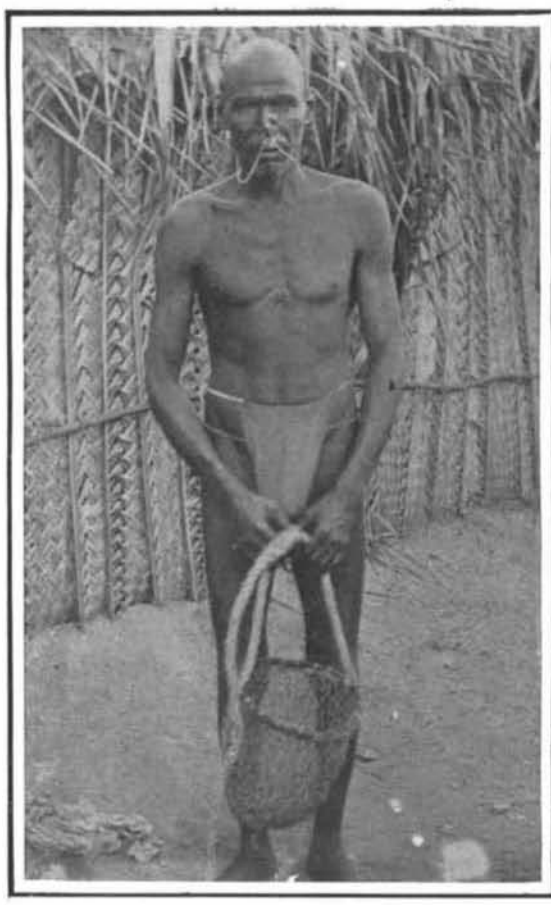
The pearl-bearing cestode is not a true oyster for edible purposes but is more closely allied to the mussel family. It differs from the ordinary animal in having a "byssus" or bundle of tough threads by means of which it secures a firm adherence to suitable materials, and similar to the facilities possessed by the mussel. Attempts are being made in cultivating this oyster by artificial impregnation of the pearl-forming larvæ. Investigation is being carried out to ascertain the origin of the spat, and how it periodically disappears. In connection with this research a thorough study is being made of the sea-currents on and around the oyster banks and of the surface drift in the Gulf.

The fishery is very intermittent. Prior to 1903 there had been none for twelve years, and the situation became so serious that a commission was appointed to investigate the subject. In 1905 the harvest was the greatest on record. Over 80,000,000 oysters were collected, realizing some $1,250,000, two-thirds going to the island's treasury. In the subsequent two years it dwindled regularly and 1908 proved barren. It is against the recurrence of intermittent fat and lean years that scientific developments are being conducted, so that the fishery each year may be of more steady and reliable proportions. By the assistance of science it is anticipated that the speculative character of the enterprise may be almost eliminated. During the past few years the tendency toward "community of interests" had developed among the natives at the auction sales. A "ring" was formed to bring prices down, at the same time keeping out small purchasers, but an officer promptly suspended the auction indefinitely. The members of the ring, apprehensive that their journey to the island would prove abortive, broke up, since which time there has never been any attempt at "combination."

Method of extracting pearls from oysters by merchants.



Examining shell refuse for pearls that escape detection in washing the oyster.

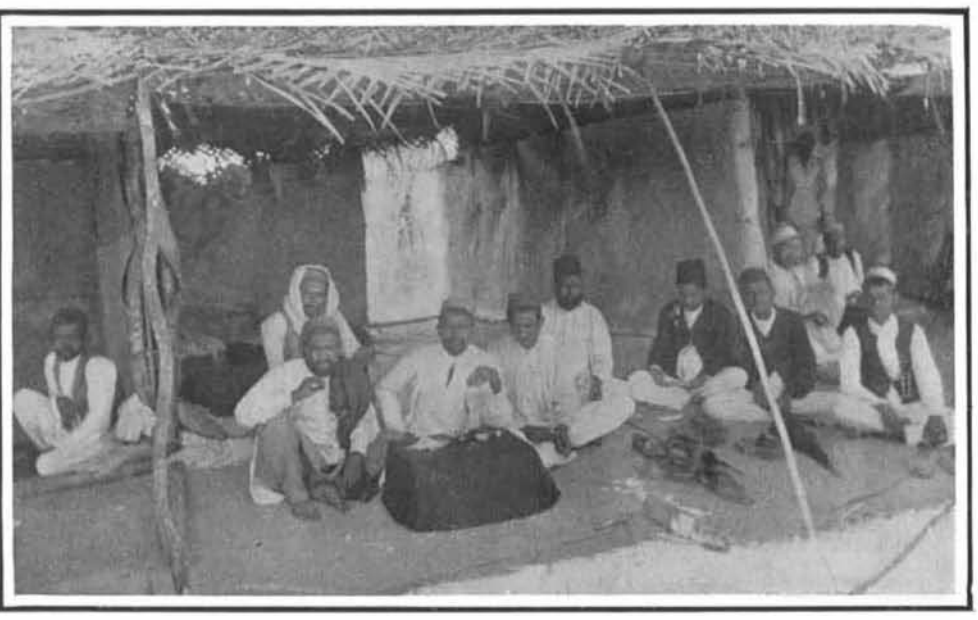


Nostrils of Arab diver closed by horn before diving.

Oyster boats coming in from the sea beds.

A native diver cleaning oysters and finding a pearl.

Counting oysters in the Goot Kottu. A process which is no longer in general use.



Pearl merchants weighing the gems on sensitive scales with seeds as weights.

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The Dissipation of Fog and Smoke.

The experiments of Aitken have proved that dust particles play a very important part in the formation of fogs, by serving as nuclei for the condensation of water vapor. The electric and electrified particles known as ions are still more effective in condensing saturated water vapor, because their electric charges strongly attract and retain the water, thus counterbalancing the effect of surface tension, which promotes evaporation from the surfaces of drops of very small diameter. Hence ionization may produce fog and it may also destroy fog by collecting minute drops into large drops, which fall as rain.

In 1884, before Aitken's researches, Sir Oliver Lodge discovered that an electric spark discharge (which is now regarded as a stream of ions impelled by electric force) quickly dissipates smoke and dust clouds, and he has since employed the same means for the dissipation of fogs. These experiments, which have a great interest for railway and maritime traffic, are being conducted at great expense, especially in Liverpool, in the hope of keeping the suburban railway lines clear even in the foggiest weather.

About a year ago a French engineer, M. Dibos, began a series of experiments in the dispersion of fog by Hertzian waves and lately he has improved his apparatus by the addition of oxyhydrogen flames, states Cosmos. The effect produced by these flames may be partly caused by their heating the air but it is probably due chiefly to ionization, for it is well known that flames produce vast numbers of ions, or electrified particles, which become disseminated through the atmosphere.

The first decisive experiments with the flames were made on December 25th, 1908. The aerial waves were generated by an inductor of about 400,000 volts. Above the conical antenna by which the waves were emitted was placed a metal ring of smaller diameter which carried a large oxyhydrogen jet at each of the cardinal points of the compass. The four jets were connected by India rubber tubes to a central gas holder, which was supplied by a battery of cylinders containing compressed oxygen and hydrogen. The fog, which had prevailed for a week, was very thick that morning. When the emission of aerial waves commenced the oxyhydrogen flames had attained a temperature of 3,600 deg. F.

By the addition of the flames, the time required to clear the space surrounding the antenna was reduced from 40 minutes to 20 or 30 minutes and the diameter of the clear zone was greater than in the previous experiments with Hertzian waves alone, increasing from 400 feet to 500, 530, and 560 feet. The effect was maintained for nearly two hours and until the experiment was stopped by the exhaustion of the supply of oxygen. On the afternoon of the following day experiments with the Hertzian waves alone were commenced, but were discontinued in a few minutes, as the wind had shifted to the northeast and the fog was quickly dispersed by a brisk breeze from the North Sea. (These experiments were performed at Wimereux on the shore of the English Channel.)

An automobile mirror is now made based upon scientific principles. The laws of reflection and refraction are taken into proper account, so that not only is a greater volume of light projected by the lamp, but this volume is thrown just where it is wanted. The two surfaces of the mirror have curves differing in their radii the first or unsilvered surface having a deeper curve. The rays of light which strike the first surface perpendicularly pass on without refraction to the rear or silvered surface, and again reach the first surface by reflection, where they are bent or refracted. But those rays striking the mirror outside of the center do so at a greater and greater angle as the edge is approached, and are refracted more and more as the angle is increased. The marginal rays are therefore so refracted that when reflected by the silvered surface and again bent by the first surface the entire volume of reflected light is concentrated into an intense parallel beam to be directed exactly where wanted.

A HOUSE-TO-HOUSE MIRROR SYSTEM.

The idea of using mirrors to enable one to see objects without exposing one's self has found expression in more than one novel of adventure. A few patents have also been taken out for reflecting devices which render it possible to see, from a second-story room of a house, a person entering by the front door below. A New England inventor, Mr. Dana S. Dudley, has elaborated the plan on such a scale in his own town, that he is able to observe the surrounding country for a considerable distance, merely by looking down a tube mounted in his back yard.

Mr. Dudley's system may be employed for reflecting to a receiving station images of objects and persons in remote apartments of the same house or distant houses. The system comprises, as may be supposed,

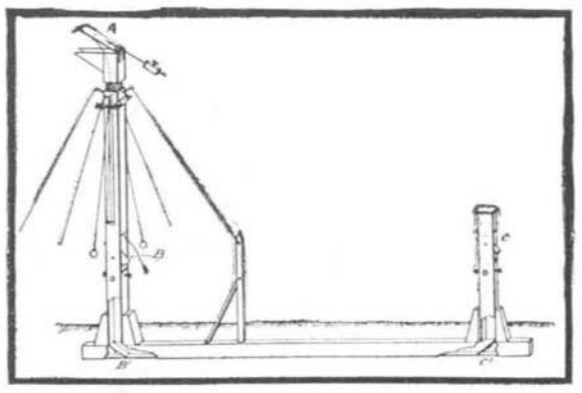
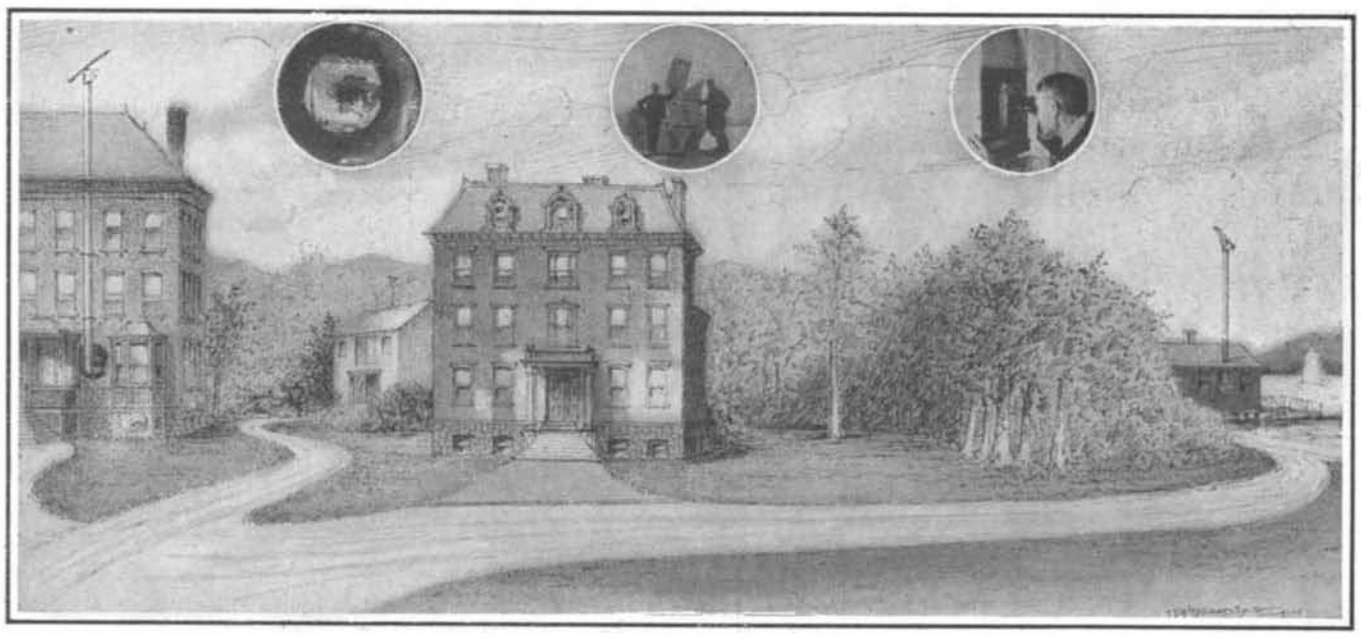


Diagram showing arrangement of mirrors and tubes.

a series of main pipes or tubes and branch tubes about a foot in diameter, which ramify a house, or which may be extended underground from one house to another beneath an intervening structure. Plane mirrors are mounted in the tubes for the purpose of reflecting the images around corners, from one tube to another. Either by electrical or mechanical means it is possible to operate a particular mirror in a particular room from a central station and cut off reflections from all other mirrors in the system, so that objects in that particular room alone may be seen. Any of the visual tubes entering the central station may be thus connected with each other.

One form of the invention (one of the simplest, moreover) is illustrated in the accompanying drawings. The object of this particular form is to render it possible to see at the point *A* whatever may be happening at the point *C*, despite the fact that a building intervenes, as shown in the drawing. At *A* and *C*, twelve-inch mirrors are mounted on ball-bearing trunnions and swiveled on a vertical axis, so that they can



The small circular pictures show respectively an image of a face transmitted through several rooms and back again; a swiveled hood on a house-top, containing a mirror; a receiving station with telescopic eye-piece.

A HOUSE-TO-HOUSE MIRROR SYSTEM.

be turned up and down and from side to side. These mirrors are designed to reflect images through tubes leading downwardly into the ground and communicating with a horizontal tube buried in the ground and passing either under or through a house situated between the stations *A* and *C*. At the points of the vertical and horizontal tubes, mirrors *B'* and *C'* are mounted at such an angle that they will reflect the image from the mirrors *A* and *C* either through the vertical tubes or through the horizontal tubes. If the image reflected to the receiving mirror is that of an object so distant that it appears very small, telescope eyepieces can be employed to magnify it, the effect being much the same as if the distant object were observed through a spy-glass.

By means of this mirror system of his, the inventor has succeeded in obtaining some very curious effects. His arrangement of mirrors and tubes in his own house enabled him to send his own reflection through several rooms and back to himself again, so that he saw himself as if afar. He could look around the house through one lens of the telescope eyepiece and see his other eye. Two persons seated next to each other at the receiving mirror and separated by a screen could see each other clearly, after their images had been transmitted through room after room, the faces appearing remotely distant, although the two were near enough to shake hands. Mr. Dudley has also used his apparatus to reflect sunlight into cellars and dark rooms, the first mirror being so mounted that it could follow the sun's movement, as in the case of a heliostat.

Telephones can be employed in connection with this system, so that two persons may talk to each other and see each other at the same time.

A New Phonograph.

Consul Thomas H. Norton, in the following report from Chemnitz, describes a new German invention which combines the phonograph and the siren:

The methods for recording sound have reached a higher stage of perfection than those employed for its reproduction. The chief difficulty encountered in the present systems of reproducing conversation, and especially music, from phonographic and similar records, is caused by the friction of the needle resting upon the surface of the rapidly revolving disk or cylinder. This introduces a more or less noticeable buzzing or rumbling sound, which interferes materially with the clearness of musical notes or spoken words. Numerous attempts have been made to overcome this unpleasant accompaniment. In none of the devices hitherto brought forward has complete success been attained, since all involved the factor of friction as the fundamental means of transmission.

In a recent number of the Deutsche Musikwerk-Industrie, a German inventor describes a newly patented instrument, in which friction is completely avoided. It combines the leading elements of the phonograph and the siren. The novel and essential feature is the substitution of a current of compressed air for the needle or stylus of Edison's invention.

In a siren, openings of various sizes allow the production of all musical notes with any desired degree of intensity or length. In the new instrument, perforations in the disk of a siren are replaced by tangential incisions on the surface of a large record cylinder. A second perfectly smooth cylinder rests close upon the surface of the first cylinder and revolves in unison with it as the two cylinders are set in movement. A constantly varying succession of minute openings between their surfaces is presented, due to the incisions on the record cylinder. When a powerful blast of compressed air is directed upon the line of contact between the two cylinders, at such an angle as to be an exact tangent to the surfaces of both, sounds are evoked identically as in the case of an ordinary siren. It is possible to communicate signals and even words which can be readily heard miles away.

It is already evident that a field of usefulness is open to this new invention as an adjunct to the equipment of seagoing vessels. Its availability for musical purposes has not yet been tested sufficiently to determine whether it can successfully vie with the gramophone, phonograph, etc., or even replace them.

The cylinders thus far employed are about ten times as large as ordinary phonographic cylinders, and this fact renders the instrument necessarily somewhat clumsy. The requirement of a current of compressed air may also militate against a widespread domestic use, although such a current can be supplied by a comparatively inexpensive attachment to a water tap where the water supply is under considerable pressure.

Illuminating Mass for Pyrotechnic Purposes.—Take 36 parts of nitrate of baryta, 15 parts of iron filings, 1 to 10 parts of aluminium powder, 1 part stearine, 3 parts of sugar of milk, and 3 parts of dextrine.