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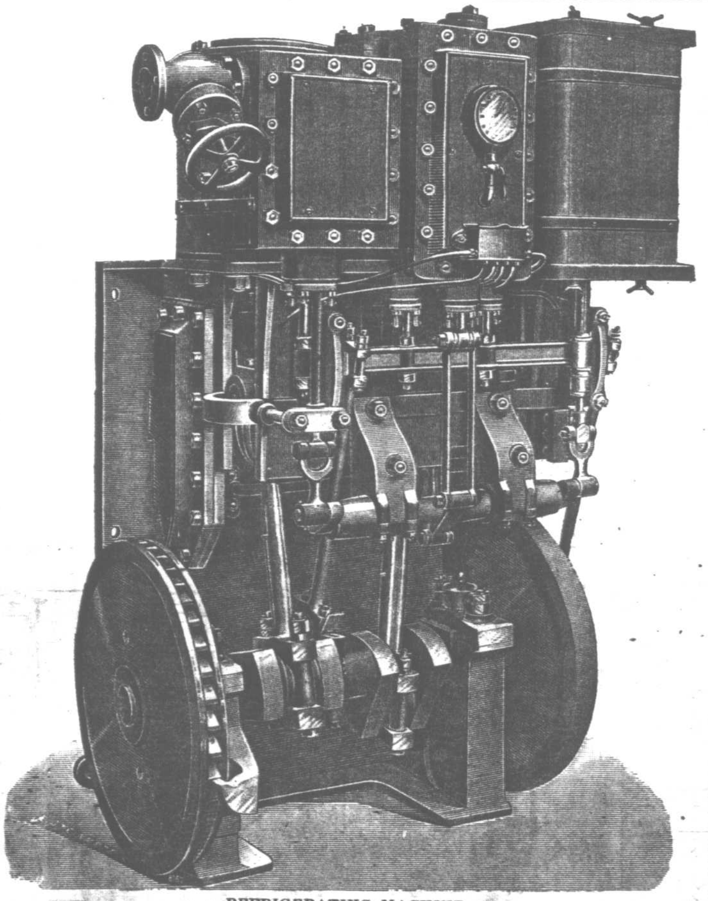
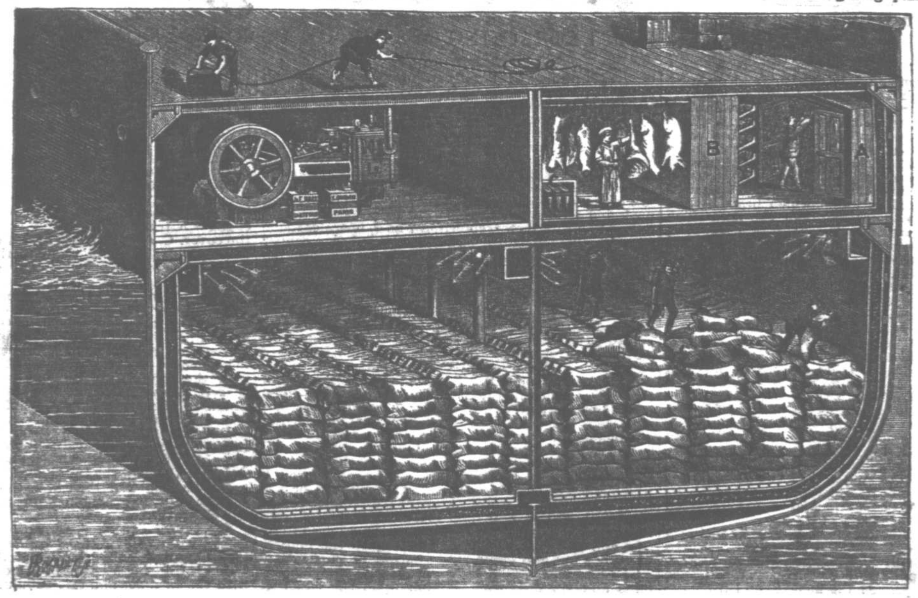
COLD STORAGE ON SHIPBOARD.

ON board ship lunch and dinner are to the passenger the chief events of the day, to be looked forward to during the tedious hours which are so difficult to fill, as brief intervals during which the attention is fully and pleasantly engaged. Probably this was always the case, even in the East Indiaman, which often occupied six months in her voyage. But how different were the meals then served from those which appear in the saloons of the great lines of steamers now running to India and Australia! The fresh provisions had all to be carried alive, and during the short time they spent on the decks the animals deteriorated woefully. The fowls became as spare as greyhounds, and apparently quite as muscular, while the bullocks and the sheep lost flesh and flavor until they would bear comparison with nothing but salt junk. The water and the wine grew lukewarm in the tropics, and there was neither fresh fruit nor vegetables to vary the fare. Now, after the seasickness is over, a passenger eats more and enjoys it better than ever he does on land. The fresh air gives him a splendid appetite, and at every meal he finds a bill of fare corresponding to that of a first-class hotel on shore, while the viands and the cooking are both of the best. This change is due to the introduction of cold storage on board ship. The meat, milk, fruit, and vegetables are defended from decay by being kept in a room at a freezing temperature, and are used as required. Often thousands of carcasses are carried in the hold to be consumed in England after having lived and been killed in Australia and New Zealand. The method of storage and refrigeration is shown in the lower engraving. The carcasses are cooled on shore to a temperature of 45° to 50° Fahr. below freezing, and brought on board perfectly hard and rigid. They are stacked in rows in a chamber formed in the hold, and inclosed within double walls filled in with ground charcoal. Along the center of the chamber there runs a perforated trunk through which the cold air from the refrigerating machine is emitted. The air sinks through the rows of carcasses, which rest on battens or gratings, not shown in the engraving, and is afterward drawn out through trunks placed against the sides of the chamber, to the refrigerating machine, which in the illustration is one by Messrs. J. & E. Hall, of Dartford. There is a large trade of this kind carried on between Barracas, in the Argentine Republic, and France, and it is found that after paying a duty of £4 7s. 6d. a ton on the meat and a city octroi of £4 13s. 4d. a ton, the shippers can make a profit of £3 3s. 6d. a ton.

The provisions carried for the ship's use are stored in a chamber between decks. There are wine cooling racks, A, a water cooler, B, ice pails, C, besides hooks and racks for other viands. Where a ship is not designed to carry carcasses for consumption in Europe, and has only to supply her own needs, a much smaller refrigerating machine suffices.



REFRIGERATING MACHINE.



COLD STORAGE ON SHIPBOARD.

The machines usually made for this purpose have been designed to work horizontally, and owing to the space which they occupied, it has been necessary to place them away from the engine room in the hold or 'tween decks, thus reducing the space available for cargo and requiring special attendance. The machine illustrated is usually bolted up against the after bulkhead in the main engine room, and thus comes under the care of the engineer on watch, who can run it as the temperature of the cold chamber requires, a thermometer to show this being within his reach.

As much as 8 to 10 tons of meat, vegetables, etc., including all the milk, butter, and other perishable stores, can be preserved with this little machine without throwing any appreciable additional working expenses on the ship and with very little attention from the engineer on duty. The principles on which these cold air machines are based have been so often described that it will be sufficient to mention that the cold is produced merely by the compression and expansion of atmosphérie air, without the use of any chemical material.—*Engineering.*

NIGHT NAVIGATION ON THE SUEZ CANAL.

AN interesting paper has been read by M. P. Lemonnier before the International Society of Electricians, at Paris, in which he gave some particulars regarding the use of electric search lights on vessels passing through the Suez Canal by night. It appears that since March, 1887, when night traffic was first permitted, some eight hundred vessels have passed through the canal by the aid of the electric light. Of these, slightly over three hundred carried their own lighting plant, the rest of the vessels having obtained the plant from one of the two companies who make it a business to supply the necessary apparatus on hire.

These firms are the Societe Bazin & Cie., whose plant is of English make, and the Societe Worms, Josse & Cie., whose plant is of French make, being manufactured by Messrs. Sautter - Lemonnier & Cie. These firms have depots at either end of the canal, and upon a vessel arriving the plant is hoisted on board, installed by the firms' servants, and superintended by them throughout the passage.

On arriving at the other end of the canal the plant is put on shore, and held in readiness for the next vessel passing in the opposite direction. To avoid delays, it is advantageous

[NATURE.]

THE OPENING OF THE MARINE BIOLOGICAL LABORATORY AT PLYMOUTH.

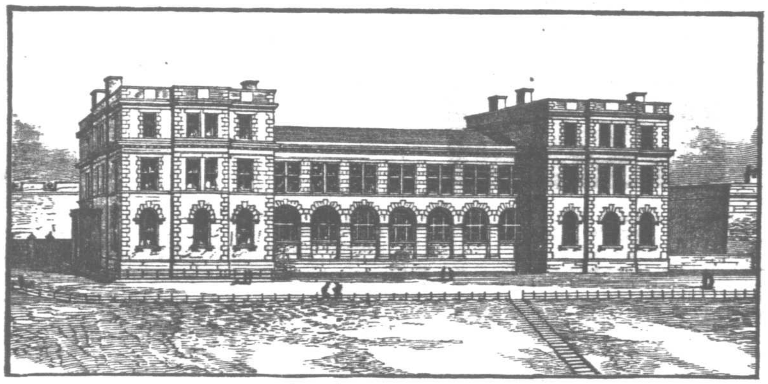
THE laboratory at Plymouth, which is now ready for work, is remarkable as being the first institution in this country designed purely for scientific research which has been originated and firmly established by the efforts of scientific men appealing to the generosity and confidence of wealthy individuals and corporations who desire the progress of knowledge for practical ends and the general good of the community.

It may be said that the Marine Biological Association began its active career on June 30.

On that day Prof. Flower, on behalf of the Association, declared the laboratory at Plymouth, which is now complete, open for the purposes of biological research. The opening of the laboratory may be said to mark an epoch in English zoological science, just as the opening of the Stazione Zoologica at Naples, which is essentially a German undertaking, marked an epoch in German science. It is true that small seaside laboratories have already been eatablished in the United Kingdom—at Granton, St. Andrews, and Liverpool Bay; but none of them can compare with the present undertaking in size and importance, and none can offer such advantages to the investigator.

The present institution, it may be remembered, is historically the outcome of the International Fisheries Exhibition held in London in 1883. That exhibition served partly as an amusement to Londoners, but it also performed a far more important service—it directed people's minds toward the importance of our fisheries, and made them in some slight degree acquainted with the conditions under which those fisheries are worked. At the close of the exhibition a large balance was left in the hands of its promoters, and it was hoped by many leading men of science that the money thus obtained would be utilized, in part at least, for the purpose of encouraging investigations upon the habits and economy of food fishes. But the money was appropriated to other purposes, excellent in themselves, though useless as a means of promoting the welfare of the fishing industry.

Prof. Lankester, however, nothing daunted by this



SOUTH FRONT OF THE LABORATORY OF THE MARINE BIOLOGICAL ASSOCIATION, ON THE CITADEL HILL, PLYMOUTH.

want of success in obtaining funds from the surplus of the Fisheries Exhibition, and feeling that it was time to strike while people's minds were awakened to the importance of our fisheries and to the lack of scientific knowledge concerning them, determined to found an association for the purpose of encouraging the study of the marine fauna of the British coasts, and with the consent and co-operation of the officers of the Royal Society called a meeting for this purpose, in the rooms of the society, on March 31, 1884. The meeting was eminently successful. The Duke of Argyll proposed a resolution to found the Marine Biological Association of the United Kingdom, and was supported by the most eminent biologists in the country. An appeal was made for subscriptions in aid of the association's projects, and was soon liberally responded to. His Royal Highness the Prince of Wales graciously consented to be patron of the association, and gave liberally to its funds; the scientific societies, the City companies, the universities, and finally her Majesty's government, joined the list of subscribers; and in a short time the association was in a position to undertake the building of a laboratory. After some debate as to the most suitable locality for a laboratory, Plymouth was selected, partly because it is a large and important fishing port, partly because the richness of the marine fauna of the Sound and neighboring shores was extoiled by such eminent authorities as the late Dr. Gwyn Jeffreys, Mr. C. Spence Bate, and Prof. Charles Stewart. The association was fortunate in securing a magnificent site for the laboratory from the War Office. For this site, than which a better could not be found, the association is greatly indebted to the Earl of Morley, then Under-Secretary of State for War, and to Sir Andrew Clarke, Inspector-General of Fortifications. The site granted is that part of the fosse of the citadel lying to the south of the portion of the citadel known as King Charles' Curtain; it has a frontage toward the sea of 265 ft., and extends some 240 ft. southward of the citadel.

The laboratory, which has been erected upon this site, is admirably adapted to the purpose of the association. It is, indeed, more than a laboratory, it is also an aquarium, whose tanks are extensive and fitted with every improvement that modern science can suggest. The total cost of building, machinery, and fittings, including all fees, has been about £12,500. The structure comprises a central portion, with a wing at either end. The east wing is almost wholly taken up by the residence of the director, and needs no further comment. The west wing has on the ground floor the caretaker's rooms, and a receiving room, into which the results of the day's fishing will be brought for examination. On the first floor are chemical and physiological laboratories and on the second floor a library, a work room, and lavatory. The main part of the building contains on the gronnd floor the aquarium or tank room, and on the first floor the large laboratory. The tank room is fitted with slate and glass tanks, of which one on the northern side is a noble window tank, 30 ft. in length, 9 ft. in breadth, and 5 ft. deep. There are three large window tanks on the north side, nine smaller window tanks on the south side, and a series of five table tanks in the middle of the room. The tanks are supplied with salt water from two reservoirs, capable of holding 50,000 gallons each.

From these the salt water is led by means of pumps through vulcanite pipes into the tanks; the openings of the pipes are placed rather more than a foot above the level of the water in the tanks, and are provided with nozzles through which the water is forced at high pressure, so as to form jets descending deep into the tank and carrying with them a quantity of atmospheric air. Circulation has been established in the tanks for the last fortnight, and there is every reason to be satisfied with the arrangements for aerating the water. The jets, carrying down the air deep into the water of the tank, cause it to be filled with minute bubbles, so as to resemble champagne, and all the animals that have hitherto been placed in the tanks are thriving in a remarkable manner, which is the more surprising as new tanks are generally supposed to be highly injurious to organisms introduced into them at an early date. It would be too much to expect that tanks which have been so lately put up should be fully stocked within a fortnight, nevertheless they will present to the visitors a sufficiently interesting collection of local marine forms. For the rest, the tank room is a plain room, without any attempt at ornamentation. It is felt that the scientific nature of the institution must be kept in the foreground, and therefore nothing has been done to make the aquarium a place of popular amusement.

The main laboratory is at present fitted with seven compartments, each to contain a single naturalist, along its north side. When the necessity arises, similar compartments will be placed along the south side. In the center of the room is a series of slate and glass tanks supplied with salt water from the circulating pumps. Beneath these a convenient shelf has been arranged, so that naturalists will be able to arrange for themselves any temporary apparatus that they may devise on as small a scale as is desired. All the arrangements for laboratory work are completed, and the only thing now required is a company of ardent naturalists ready to undertake the work that lies to hand.

The material for work and for stocking the tanks is obtained from the Sound and the sea outside the breakwater by means of the trawl, dredge, and tow net. In general a small shrimp trawl is used in preference to a dredge, as it is much wider and equally effective in collecting the animals that live at the bottom. Hitherto the association has been content to hire fishing boats for dredging and trawling. Most of the work has been done in a small hook and line boat, the Quickstep, of about 6 tons burden, and on special occasions the trawler Lola, of 50 tons burden, has been hired. But this method of hiring is too expensive to be continued; the association will soon have to purchase boats, and probably will find it necessary to acquire a steamboat. Without a steamboat the station is at the mercy of the weather. If it is a dead calm—and calms are frequent in summer along the south coast—no dredging or surface netting can be done—a cruel fate when one knows that the pelagic surface fauna swarms thickest on bright, calm days. Or if it is wished to explore a certain region on a certain day, if the winds prove contrary, more than half the day is lost in beating up to the station; in any case, one may generally expect to have a contrary wind on either the outward or the homeward journey. Such losses of time and material are most prejudicial to an institution like the Marine Biological Association. A steam launch has been found necessary at all other marine stations. Dr. Dohrn has two, the Johannes Muller and the Francis Balfour, at Naples; and the Granton station is well provided for by the steam yacht Medusa. But the funds of the association have been well nigh exhausted in the building of the laboratory. If a steam launch is found requisite, it will be necessary to make another appeal to its friends, which, let it be hoped, will be as heartily responded to as the first appeal for funds for building the laboratory.

It was stated in the early part of this article that the association began its active existence on June 30. It would have been more proper to say its active public existence, for its staff has been active for some time past. Under the guidance of Mr. W. Heape, the late superintendent, a careful though necessarily incomplete exploration of the Sound has been made, and numbers of animals have been identified, preserved, and put aside for future reference. Mr. Heape has also drawn up a complete list of the fauna and flora of the Sound, as recorded up to the present date, and a very formidable list it is.* Botanists will note that there are more than 250 species of marine Algæ recorded from the neighborhood, and some of them are extremely rare. Zoologists will see that there is an unlimited field in certain groups, particularly in the Crustacea and the Mollusca, but that some of the most interesting forms, the "pets of the laboratory," such as Amphioxus and Balanoglossus, are absent. But to say that they are absent means only that other less familiar forms are present, and that these old favorites have not been recorded. A good authority states that Amphioxus can be found in the immediate neighborhood, while it is confidently expected that both Balanoglossus and Amphioxus can be introduced from the Channel Isles, and kept alive in the tanks. The zoologist need not fear that he will be hindered by the poverty of the fauna; there is material enough and to spare. The remarkable Hydroid, *Myriothela*, occurs at low tide, marked in considerable quantities. The interesting Actiniæ, *Edwardsia* and *Peachia*, are to be found. Appendiculariæ and Sagittæ are taken in hundreds in the tow net. *Antedon rosaceus* is abundant a quarter of a mile from the laboratory, and magnificent specimens of Pinna will attract the interest of the malacologist.

Such an institution as that of Plymouth challenges comparison with Dr. Dohrn's famous zoological station at Naples. But there is this remarkable difference between them. The Naples station was founded for purely scientific objects; it does not profess to undertake investigations for the benefit of economic interests. The Marine Biological Association receives an annual grant from the treasury, on the express understanding that it shall conduct researches upon questions relating to the life history and habits of food fishes. It must not be supposed that this work is not scientific because it has a practical object in view. Science is not only the art of thinking correctly, but of observing and recording correctly, and correct observations and records of the life history of our food fishes are just what are wanted at the present time. The work of Mr. J. T. Cunningham, naturalist of the association, is an admirable example of scientific method as applied to a practical investigation. Mr. Cunningham has been working for several months at the development of fishes, with the view of obtaining and artificially fertilizing their ova and rearing their young in captivity. His results are necessarily incomplete, as he has been working in a half-finished laboratory, without gas or water, and under unfavorable conditions as regards boats and men. But he has succeeded in tracing out the life history of the "merry sole" (*Pleuronectes microcephalus*), and has acquainted himself with such important facts concerning the development of the common sole that he confidently expects to be able to hatch out the young next season, his experiments this year having failed only for want of the proper apparatus. He has also recorded the interesting fact that the herring spawns continuously from January to June in the Channel, and appears to have no definite breeding season, as it has in northern waters; and has discovered important facts relative to the breeding of the mackerel, conger, and pilchard, which will be made public as soon as his researches are complete. He has now stocked one of the large tanks in the aquarium with conger, and hopes in a short time to give a final opinion on the obscure question of the breeding of this fish. Not less interesting than Mr. Cunningham's researches are those of Mr. Weldon on the breeding of the common lobster and the rock lobster or craw-fish (*Palinurus*). Another of the tanks in the aquarium is occupied by the "berried" females of these forms, whose bright colors and active movements are as attractive to the casual spectator as their study is interesting to the zoologist and fisherman. So much has been done already by Messrs. Cunningham and Weldon under the most unfavorable conditions that it cannot but be anticipated that when a number of investigators are working under favorable conditions on different groups, but with a common object in view, results of the greatest scientific and practical importance will acrue.

The ceremony on June 30 was interesting and important. Many of the leading biologists in England were present, but unfortunately the eminent president of the Association, Prof. Huxley, was absent on account of ill-health, and so, unfortunately, was Prof. Moseley, one of its most ardent and generous supporters. The Fishmongers' Company added to their munificent patronage of the institution by undertaking the entertainment of the numerous guests who had been invited to the ceremony; and the Association was launched on its career of usefulness in a manner worthy of its aspirations, and satisfactory in the highest degee to its energetic promoters. G. C. B.

PERSONAL IDENTIFICATION AND DESCRIPTION.†

PERHAPS the most beautiful and characteristic of all superficial marks are the small furrows with the intervening ridges and their pores that are disposed in a singularly complex yet even order on the under surfaces of the hands and the feet. I do not now speak of the large wrinkles in which chiromantists delight, and which may be compared to the creases in an old coat or to the deep folds in the hide of a rhinoceros, but of the fine lines of which the buttered fingers of children are apt to stamp impressions on the margins of the books they handle, that leave little to be desired on the score of distinctness. These lines are found to take their origin from various centers, one of which lies in the under surface of each finger tip. They proceed from their several centers in spirals and whorls, and distribute themselves in beautiful patterns over the whole palmar surface. A corresponding system covers the soles of the feet. The same lines appear with little modification in the

* Mr. Heape's list will be published in the forthcoming number (No. II.) of the Journal of the Marine Biological Association.

† Abstract from a lecture given by Francis Galton, F.R.S., at the Royal Institution, on Friday evening, May 25, 1888.

hands and feet of monkeys. They appear to have been carefully studied for the first time by Purkinje in 1822; since then they have attracted the notice of many writers and physiologists, the fullest and latest of whom is Kollman, who has published a pamphlet upon them, "Tastapparat der Hand" (Leipzig, 1883), in which their physiological significance is fully discussed. Into that part of the subject I am not going to enter here. It has occurred independently to many persons to propose finger marks as a means of identification. In the last century, Bewick, in one of the vignettes in the "History of Birds," gave a wood cut of his own thumb mark, which is the first clear impression that I know of. Some of the latest specimens that I have seen are by Mr. Gilbert Thomson, an officer of the American

FIG. 1.—ENLARGED IMPRESSIONS OF THE FORE AND MIDDLE FINGER TIPS OF THE RIGHT HAND OF SIR WILLIAM HERSCHEL, MADE IN THE YEAR 1860.

Geological Survey, who, being in Arizona, and having to make his orders for payment on a camp sutler, hit upon the expedient of using his own thumb mark to serve the same purpose as the elaborate scroll engraved on blank checks—namely, to make the alteration of figures written on it, impossible without detection. I possess copies of two of his checks. A San Francisco photographer, Mr. Tabor, made enlarged photographs of the finger marks of Chinese, and his proposal seems to have been seriously considered as a means of identifying Chinese immigrants. I may say that I can obtain no verification of a common statement that the method is in actual use in the prisons of China. The thumb mark has been used there as elsewhere in attestation of deeds, much as a man might make an impression with a common seal, not his own, and say,

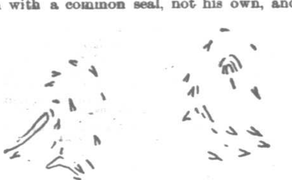


FIG. 2.—POSITIONS OF FURROW HEADS AND BIFURCATIONS OF FURROWS, IN FIG 1.

"This is my act and deed;" but I cannot hear of any elaborate system of finger marks having ever been employed in China for the identification of prisoners. It was, however, largely used in India, by Sir William Herschel, twenty-eight years ago, when he was an officer of the Bengal Civil Service. He found it to be most successful in preventing personation, and in putting an end to disputes about the authenticity of deeds. He described his method fully in *Nature* in 1880 (vol. xxiii., p. 76), which should be referred to by the reader; also a paper by Mr. Faulds in the next volume. I may also refer to articles in the American journal *Science*, 1886 (vol. viii., pp. 166 and 212).

The question arises whether these finger marks remain unaltered throughout the life of the same person. In reply to this, I am enabled to submit a most interesting

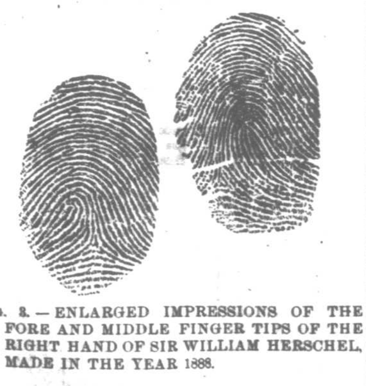


FIG. 3.—ENLARGED IMPRESSIONS OF THE FORE AND MIDDLE FINGER TIPS OF THE RIGHT HAND OF SIR WILLIAM HERSCHEL, MADE IN THE YEAR 1888.

piece of evidence, which thus far is unique, through the kindness of Sir William Herschel. It consists of the imprints of the first two fingers of his own hand, made in 1860 and in 1888 respectively; that is, at periods separated by an interval of twenty-eight years. I have also two intermediate imprints, made by him in 1874 and in 1883 respectively. The imprints of 1860 and 1888 have now been photographed on an enlarged scale, direct upon the engraver's block, whence Figs. 1 and 3 are cut; these woodcuts may therefore be relied on as very correct representations. Fig. 2 contains the portion of Fig. 1 to which I am about to draw attention. On first examining these and other finger marks, the eye wanders and becomes confused, not knowing where to fix itself; the points shown in Fig. 2 are those it should select. They are those at which each new furrow makes its first appearance. The furrows may originate in two principal ways, which are not always clearly distinguishable: (1) the new furrow may arise in the middle of a ridge; (2) a single furrow may bifurcate and form a letter Y. The distinction between (1) and (2) is not greatly to be trusted, because one of the sides of the ridge in case (1) may become worn, or be narrow and low, and not always leave an imprint, thus converting it into case (2); conversely, case (2) may be changed into (1). The position of the origin of the new furrow is, however, none the less defined. I have noted the furrow heads and bifurcations of furrows in Fig. 1, and shown them separately in Fig. 2. The reader will be able to identify these positions with the aid of a pair of compasses, and he will find that they persist unchanged in Fig. 3, though there is occasional uncertainty between cases (1) and (2). Also there is a little confusion in the middle of the small triangular space that separates two distinct systems of furrows, much as eddies separate the stream lines of adjacent currents converging from opposite directions. A careful comparison of Figs. 1 and 3 is a most instructive study of the effects of age. There is an obvious amount of wearing and of coarseness in the latter, but the main features in both are the same. I happen to possess a very convenient little apparatus for recording the positions of furrow heads. It is a slight and small but well-made wooden pentagraph, multiplying fivefold, in which a very low power microscope, *with coarse cross wires*, forms the axis of the short limb, and a pencil holder forms the axis of the long limb. I contrived it for quite another use—namely, the measurement of the length of wings of moths in some rather extensive experiments that are now being made for me in pedigree moth breeding. It has proved very serviceable in this inquiry also, and was much used in measuring the profiles spoken of in the last article. Without some moderate magnifying power, the finger marks cannot be properly studied. It is a convenient plan, in default of better methods, to prick holes with a needle through the furrow heads into a separate piece of paper, where they can be studied without risk of confusing the eye. There are peculiarities often found in furrows that do not appear in these particular specimens, to which I will not further refer. In Fig. 2 the form of the origin of the spirals is just indicated. These forms are various; they may be in single or in multiple lines, and the earlier turns may form long loops or be nearly circular. My own ten fingers show at least four distinct varieties.

Notwithstanding the experience of others to the contrary, I find it not easy to make clear and perfect impressions of the fingers. The proper plan seems to be to cover a flat surface, like that of a piece of glass or zinc, with a thin and even coat of paint, whether it be printers' ink or Indian ink rubbed into a thick paste, and to press the finger lightly upon it so that the ridges only shall become inked, then the inked fingers are pressed on smooth and slightly damped paper. If a plate of glass be smoked over a paraffin lamp, a beautiful negative impression may be made on it by the finger, which will show well as a lantern transparency. The blackened finger may afterward be made to leave a positive impression on a piece of paper, that requires to be varnished if it is to be rendered permanent. All this is rather dirty work, but people do not seem to object to it; rivalry and the hope of making continually better impressions carries them on. It is troublesome to make plaster casts; modeling clay has been proposed; hard wax, such as dentists use, acts fairly well; sealing wax is excellent if the heat can be tolerated; I have some good impressions in it. For the mere study of the marks, no plan is better than that of rubbing a little thick paste of chalk ("prepared chalk") and water or sized water upon the finger. The chalk lies in the furrows and defines them. They could then be excellently photographed on an enlarged scale. My own photographic apparatus is not at hand, or I should have experimented in this. When notes of the furrow heads and of the initial shape of the spiral have been made, the measurements would admit of comparison with those in catalogued sets, by means of a numerical arrangement, or even by the mechanical selector described in the last article. If a cleanly and simple way could be discovered of taking durable impressions of the finger tips, there would be little doubt of its being serviceable in more than one way.

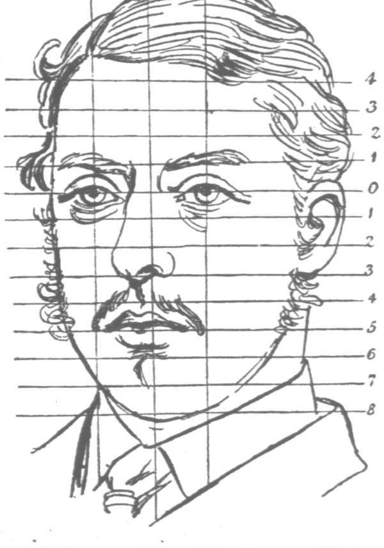
In concluding my remarks, I should say that one of the inducements to making these inquiries into personal identification has been to discover independent features suitable for hereditary investigation. It has long been my hope, though utterly without direct experimental corroboration thus far, that if a considerable number of variable and independent features could be catalogued, it might be possible to trace kinship with considerable certainty. It does not at all follow because a man inherits his main features from some one ancestor, that he may not also inherit a large number of minor and commonly overlooked features from many ancestors. Therefore it is not improbable, and worth taking pains to inquire whether each person may not carry visibly about his body undeniable evidence of his parentage and near kinships.

PERSONAL IDENTIFICATION.

IT is generally held that men have attained their natural stature about the age of twenty-four. It may, in addition, be desirable to ascertain to what appreciable extent difference of facial dimensions ensues between the ages of say fourteen and twenty-four. In the celebrated Tichborne case, the differences to be determined lay between portraits taken at the age of twenty-five and those taken at the age of forty and onward. During subsequent life—excepting from the loss of teeth, which would deduct proportionately from the depth of the chin—no appreciable change in the osseous fabric can be theoretically assumed.

Externally, appearances may differ much; but in that case the issues raised are mostly those of beard or no beard, fat cheeks or lean cheeks, blotches, wrinkles, and crows' feet; or no blotches, wrinkles, and crows' feet. Now, without doubt, fatness in lieu of leanness produces a very perceptible difference to the eye, and with superficial observers might invalidate the admeasurement. But such must be reminded that superior plumpness constitutes simply a straight out projection, that adds not a fraction to the flat surface of the picture. Within the boundaries of the area measured, the same identical proportions and distances subsist between the eyes, the lips, and the chin. In a photograph—whether the object be as rotund as a globe or as flat as a dinner plate—no possible difference can ensue if the diameters are in agreement.

Here, perhaps, I may suitably pause, leaving to a future opportunity some of the additional and more vital of the issues involved. The portrait here ap-



pended will answer fairly well the purpose of illustrating the principles of the admeasurement.

It will be seen that through the exact center of the pupils a line is drawn, from side to side (marked 0 in the portrait); and thus is secured the first necessity, a valid horizontal, and a basis for all further operations. Bringing the distance between the centers of the pupils to our aid, we next strike intersecting arcs above and below the horizontal; upon these arcs being connected by a line passing through the points of their intersection, we arrive at the indispensable requisite, the true perpendicular and natural poise of the head, as it variously exists in each portrait.

That feature of the operation having been carefully effected, we proceed with equal care to mark off the lines representing the diameter of the iris, upward and downward—starting always from the center of the pupils.—*W. Mathews, The Photographic News.*

THE SPANISH SAFFRON TRADE.

IN the last issue of the *Handels Museum*, Mr. Theodor Mertens, of Valencia, gives some particulars about the Spanish saffron trade. The average yield of the crop in that country amounts to between 180,000 and 225,000, a quantity four-fifths of which is quite sufficient to cover the entire consumption of Spanish saffron, so that in seasons of abundant crop, when, perhaps, 290,000 to 310,000 lb. are harvested, a heavy stock accumulates, and three successive abundant crops generally cause the farmers to reduce their plantations. The lowest price at which saffron growing can be made to pay closely approaches the equivalent of 28s. 6d. per lb.

At Pithiviers, in the Gatinais (France), a maximum crop of from 27,000 to 34,000 lb. was harvested in former years, but since the severe frost which occurred in that district in 1879 the largest crop has not exceeded 11,000 lb. (in 1887 it was only about 7,800 lb.), and at present Spanish saffron unquestionably rules the market. The average Italian crop may be placed at 11,000 to 13,500 lb. per annum, and in Austria saffron growing only pays if the price is at least 53s. per lb.

This Austrian is the best of all, and next to it ranks the Gatinais, the only drawback of which is that it very quickly loses its vivid color. In Spain saffron is divided into five grades, each cultivated in a different district. The center of the export trade is Valencia, where the saffron is stored by the merchants, who generally advance money on it to the cultivators. These merchants sell it to the local agents of foreign houses, who export the drug in strong wooden cases, with an outer covering of matting, about 160 lb. weight, and in which the saffron is packed in white paper. For export to distant countries, however, the saffron is generally packed in tins, which are placed in a wooden case.

The principal buyers of Spanish saffron are a few firms in southern Germany—Mannheim, Frankfort-a-M., Hanau, and Wurzburg—who pick and grade it, remove the yellow threads, leaving only the purely red filaments, or grind it, and redistribute it subsequently to all parts of the world. Pithiviers and Marseilles used to buy large quantities in Spain, but do not now take quantities of any importance. Other countries purchasing direct from Spain are England, North America (California), South America, especially Buenos