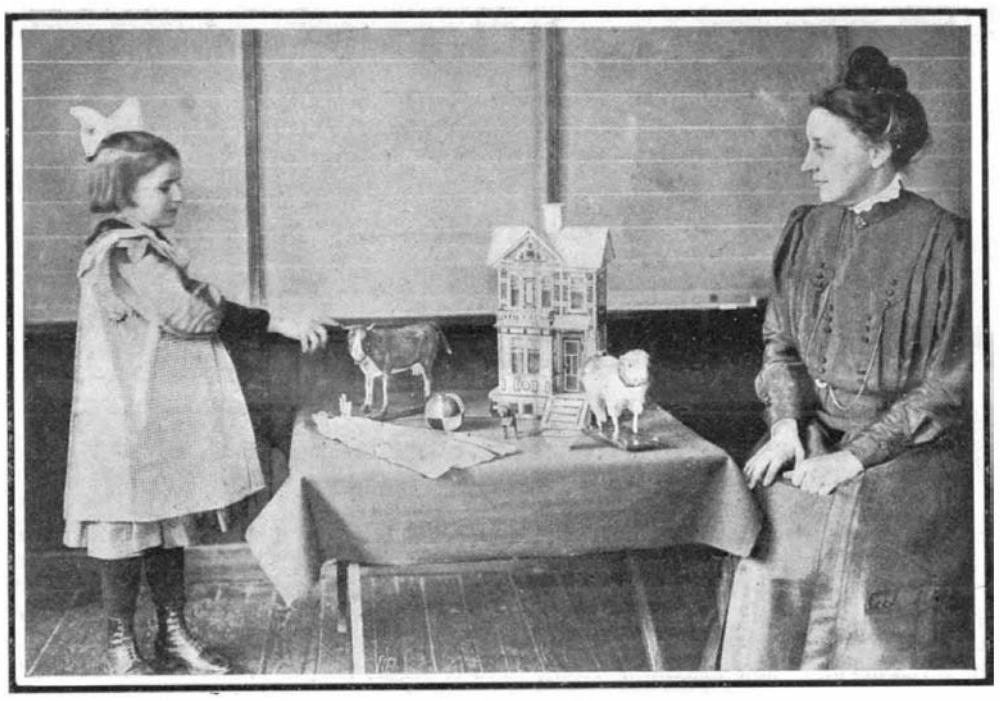
do not know the value of inflection, and hence speak with a dead tone which is quite pathetic. But there is nothing else to excite sympathy, for the children seem very happy. Every room has its corner filled with toys, which are used in explaining the names of objects. A child born deaf knows a cow by sight, but does not know that it is called a cow. Therefore, after the rudiments of articulation have been imparted to him, the next step is to teach the child to speak the names of the various objects about him. The teacher points to the toy cow, and makes the facial contortion necessary to articulate the word. The child imitates, and soon has the word correctly spoken. Then he is sent to the blackboard, and is taught to write the name of the animal. Thus he is able to connect the written and spoken language. Simple sentences are taught in a similar manner. A child is given a ball. He knows perhaps by this time how to pronounce the word *ball*, but he must be taught to use the word in a sentence. Another child is called up, and the first child is told to throw the ball into the hands of the second pupil. The teacher explains that the action is expressed by the word *throw*. Then the class is taught that the way to express that action is to say, "I threw the ball." Having learned that much, the thrower writes the sentence down on the blackboard, and the class repeats the line over and over again, a tendency to wrong accentuation being corrected in each one, as is necessary.

The development of language follows a clearly defined arrangement of grammatical principles. These principles, however, are not given the child as such, but serve as an aid to the teacher in the selection and arrangement of exercises in simple English—such natural English as will most readily lend itself to the needs of the child's daily life. Thus, language is at first interpreted to him by the use of objects, actions, and pictures. The four or five years of the primary course are devoted almost exclusively to the acquirement of language and numbers, with introductory lessons in geography. In the grammar school department arithmetic, geography, history, and natural sciences are taught as nearly as possible according to the best methods employed in an ordinary school. The formation of the speech habit and the reading habit is considered of paramount importance. As soon as the child has been taught spontaneously to express himself in spoken language, and to look for such expression in others, he is shown the delightful things that are to be found on the printed page.

In the modern schools for the deaf, the pupils are not only taught intelligible speech, but trades as well. The older girls are taught wood carving, drawing, cooking, and sewing; the boys are taught printing, cabinet making, drawing, tailoring, etc. The perfection of the oral method of instruction is strikingly noted by the fact that congenital mutes are, at the time of the completion of their course, able to speak so perfectly, that it is difficult to distinguish their voices from those of normal persons. After graduation many pupils enter high schools, and sometimes colleges. Thus the transformation is accomplished, and the once considered unteachable deaf-mute is changed into an intelligent and respected citizen, and the deaf as a class are being highly elevated in public estimation.



Explaining the Names of Familiar Objects by Means of Toys.

TEACHING DEAF-MUTES TO SPEAK.

Stamp Machines for the Postal Service.

Exhaustive tests are to be made of several types of automatic stamp-vending machines adapted to receive one-cent and five-cent pieces for the purchase of one-cent and five-cent stamps and postal cards. Two years ago experiments were made of such devices by the Post Office Department. The committee of experts reported that the machines were somewhat crude, and, while they accomplished the purposes for which they were invented, it was found that they could not be utilized to the advantage of the department.

While department stores, hotels, drug stores, news stands, etc., usually want the privilege of selling stamps, under the regulations of the department or upon their own responsibility, there is certainly no great amount of zeal or alacrity displayed by the persons vending the stamps. The purchaser at times feels that he should apologize for imposing upon the seller, because there is no direct profit in the sale, the privilege of selling stamps being desirable for the purpose of attracting other custom. Stamp vending machines in such places would be of great convenience to the public and no inconvenience to the proprietor of a department store, drug store or news stand, who might be glad to have the business done by machinery instead of being compelled to give personal attention to stamp sales.

The Dulac System of Concrete Pile Foundation.

One of the most interesting of the newer methods of establishing firm foundations for buildings in soft ground was invented by the French engineer Dulac, and was first used on a large scale in the construction of the buildings of the Paris Exposition of 1900, where much time and money were saved by the employment of this novel system.

The compression and stiffening of the ground which are effected by wooden piling are caused by the lateral displacement of earth as the piles are driven in. Dulac produces the same result by omitting the wooden pile and allowing a conical weight, raised by the pile driver, to fall directly on the earth in which it makes a vertical cylindrical hole which is deepened by each successive impact of the weight. After the desired depth has been reached the hole is filled with concrete which is rammed very tightly.

The concrete piling thus formed possesses the great advantage of being independent of the height of the ground water. Wooden piles, on the other hand, must be driven entirely below the lowest water level in order to prevent decay.

The Dulac apparatus consists of a pile driver of the usual construction, 30 or 40 feet high, and three weights of a horizontal diameter of about 30 inches. The weight used in the beginning of the operation is conical, sharply pointed, and weighs two tons. When the hole has attained a depth of a few yards, a weight of parabolic or sugar loaf form, also weighing two tons, is substituted and used until the desired depth is reached. The entrance of water can be prevented by throwing into the hole a quantity of clay which is plastered on the side of the hole by the falling weight. The diameter of the hole, before it is filled with concrete, is only a few inches greater than that of the weights. Holes nearly 40 feet deep have been made by this method.

The filling is commenced by throwing in a quantity of stones and ramming them down with the third weight, which is flat on the bottom and weighs one ton. The effect of the ramming is to broaden as well as solidify the successive layers and thus form a very firm base for the concrete filler. The concrete is then introduced in small portions, each of which is well rammed with both the flat-bottomed and the round-bottomed weights, and the process is continued until no more concrete can be forced into the hole. The compression and lateral distension effected by this method are so great that the volume of stones and concrete employed is about five times the cubic capacity of the original hole. Thus two desirable results are produced. In the first place a number of very strong concrete pillars are formed and, in the second, the soil between these pillars is compressed very forcibly so that it becomes capable of aiding materially in the support of the building.

Hardening an ordinary drill in sulphuric acid, states the English Mechanic, makes an edge that will cut tempered steel or facilitate cutting hard rock. The acid should be poured into a flat-bottomed vessel to a depth of about ⅛ inch. The point of the drill is heated to a dull cherry red, and dipped in the acid to that depth. This makes the point extremely hard, while the remainder remains soft. If the point breaks, re-harden, but with a little less acid in the vessel.

NATURE'S TOUCH-ME-NOTS.

BY PERCY COLLINS.

Nature is no haphazard experimenter. She is striving to promote the strength and fitness of her children, and by the process which we term "natural selection" is constantly weeding out the weaklings and evolving more perfect types. But Nature is not needlessly changeful. When she has discovered a good device she repeats it over and over again.

A striking example of this is seen in protective prickles. Nature seems to have proved that under certain conditions prickles form the best possible protective armament, and she has emphasized her discovery by an enormous number of instances, each brought through a different channel of development to the same conclusion. In the plant world, as everyone knows, prickles are common in the extreme; while, with the exception of birds, every important group of animals possesses its spiny representatives.

The common hedgehog is a well-known type of protective prickliness and its habit of rolling itself into a ball when alarmed must be familiar to all. This action is made possible by its thick layer of subcutaneous muscle, the *panniculum canosus*, which is more developed than in the case of any other animal. The young of the hedgehog, when born, have the prickles soft and white; but soon after exposure to the air they harden and become effective weapons.

The widely distributed porcupines, which get their name from the French *porc-épin*, or "spiny pig," form another interesting group of prickly mammals. The porcupine is a formidable antagonist, rattling its quills and running backward at the enemy, and will often succeed in driving off a jaguar intent upon its destruction. Mammalian prickles are really tightly packed masses of hair. This is well shown in the accompanying photograph of a series of specimens selected from a porcupine skin, showing the complete gradation from an ordinary hair to a perfect, sharp-pointed quill. (Fig. 8.)

Passing over the birds, whose marvelous powers of flight and diving seem to render any highly specialized protective devices unnecessary, we come to the reptiles. Of these, the armor plating of the tortoises and turtles, and the venomous means of the snakes are all-sufficient safeguards. But among the more vulnerable lizards we find numerous examples of protective prickliness. One of the most striking is the Australian moloch, termed the "thorny devil" by the early settlers. This remarkable creature is about eight inches in length, and its skin is studded all over with sharp, conical thorns. The moloch is very sluggish in its habits, feeding mainly upon ants, for which it lies in wait. One would imagine it to be exposed to continual attack from birds and rapacious animals; yet no animal is more perfectly immune. Its prickles are its safeguard. Equally well protected but perfectly harmless lizards are the so-called "horned toads" of California and Mexico. About twelve species of these quaint-looking creatures are known, all being alike in the possession of a formidable array of spines—several long ones at the back of the head, and a vast number of lesser prickles all over the back and limbs. (Fig. 12.)

Of fishes, a large number are protected from hostile attack by a covering of prickles. By far the most curious examples are the globe fishes, or "sea hedgehogs" of the Atlantic and Indo-Pacific oceans. The extreme length of the globe fish is something less than two feet. It has thick lips and goggle eyes which give it the appearance of a good-natured countryman. Courage it seems to lack, and one might suppose that such a simpleton would fall an easy prey to the first shark or dogfish it encountered. Yet the globe fish is able to take care of itself. It never, under any circumstances, attacks the enemy, yet is always ready to receive him in a suitable manner should he provoke hostilities. Let us suppose that a shoal of globe fishes is swimming tranquilly in the clear waters when it is suddenly surprised by a hungry shark. Of course the little fellows scuttle hither and thither in uncontrollable alarm. But the shark, poising himself upon his powerful tail, leisurely singles out one of the fleeing globe fishes, and sets out in pursuit. Now although the globe fish is a good swimmer, it is no match for the shark. The chase is in every way unequal and can have but one ending. Within a few minutes of its commencement the shark must overtake the globe fish. But the quarry is well aware of its danger. It makes a bee-line for the surface, and as soon as it gets there begins to take in great gulps of air. Then a strange thing happens. The fish that only a moment

before was thin and small begins to grow stouter and stouter until, like the frog in the fable, it seems in danger of bursting. It stops inflating itself, however, just in time to avert this catastrophe. But its skin has become as taut as a drum-head, and the whole of its body is covered with sharp, erect prickles. It has become a sea hedgehog, and the hungry shark which comes surging through the water dares not touch it, but turns tail in search of something more eatable. Of course the globe fish was covered with prickles all the time, but in periods of tranquillity these lie comfortably along its sides, just as do those of the hedgehogs. Unlike its land prototype, however, the sea hedgehog is unprovided with a special muscle for erecting its prickles, so when danger threatens, it has recourse to the mechanical method of inflating the whole body with air, or with water, if it cannot reach the surface quickly. In the sea, prickliness is a very common method of protection, especially among the smaller and more persecuted denizens. A number of large fishes, such as the plaice and cod tribes, pass much of their time searching for shell-fish, upon which they feed greedily. The plaice has particularly good teeth, which are strong and blunt. It goes nosing about in the mud of the sea-bottom, turning up cockles, razor-shells, and clams, the shells of which it cracks as easily as a schoolboy cracks a hazel nut, and feeds upon the mollusk within. But certain species of shell-fish furnished with prickly shells, seem to object to being cracked in this manner, for, when a hungry fish, rooting in the mud, comes in contact with one of these, it gets a nasty prick on the nose. Naturally, the finny searcher hastily abandons investigation in this particular direction, and the prickly mollusk is left uncracked and uneaten.

Similarly, many crabs, shrimps, and lobsters are protected by an array of spines and prickles. Crabs are much relished by certain fishes. As many as a dozen have been found in the stomach of one big cod. These, however, were a smooth-backed species, and a cod would never dare to swallow one of the thorn-backed crabs, of which numerous kinds are found in various quarters of the globe.

Before leaving the ocean, the sea-urchins, or echinoderms, must be mentioned, for, with the hedgehog, the globe fish, and the thorn-backed crab, they rank among the most prickly creatures known. They are enveloped in a wonderful shell, or test, composed of a great number of accurately fitting plates. The test is covered with needle-pointed spines, in some species these spines being eight or ten inches in length. Thus, the urchin dwells within a home the walls of which may be said to be guarded by scores of permanently fixed bayonets.

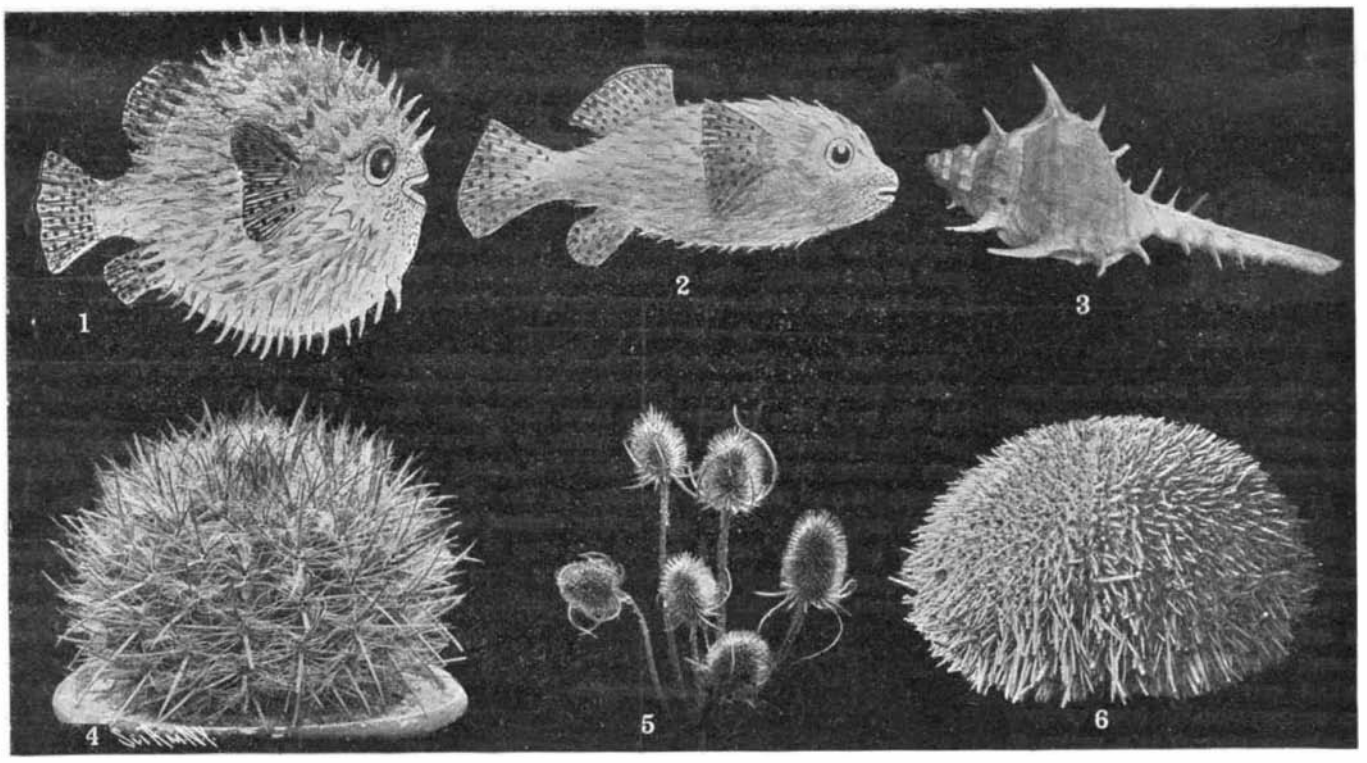
The world of insect life supplies us with myriad examples of protective prickliness. Many of the big insects, such as species from New Guinea, are simply beset with spines. Not a few caterpillars, too, are protected by closely set stiff hairs which correspond to the prickles of bigger animals, and are probably quite as effective for repelling small birds and lizards, the chief enemies of the caterpillar tribe. Some of the most remarkable insects yet discovered are certain Brazilian bugs, known as *Umbonia spinosa*. Each insect is an exact imitation of a single large thorn, such as is seen upon the stems of roses and other plants. This deceptive aspect is gained by a hard shield which completely covers the insect's body and wings, and under which its legs are drawn when it is at rest.

Turning from the animal to the vegetable kingdom, we still find prickliness a common means of protection. Sometimes we see sharp spines, which are to be regarded as modifications of branches, of leaves, or of parts of leaves. In other instances we find plants protected by true thorns, which are really massed vegetable fibers or hairs, and are therefore analogous to the quills of the mammalia. The main object of vegetable prickliness is, of course, to defeat the attacks of browsing animals.

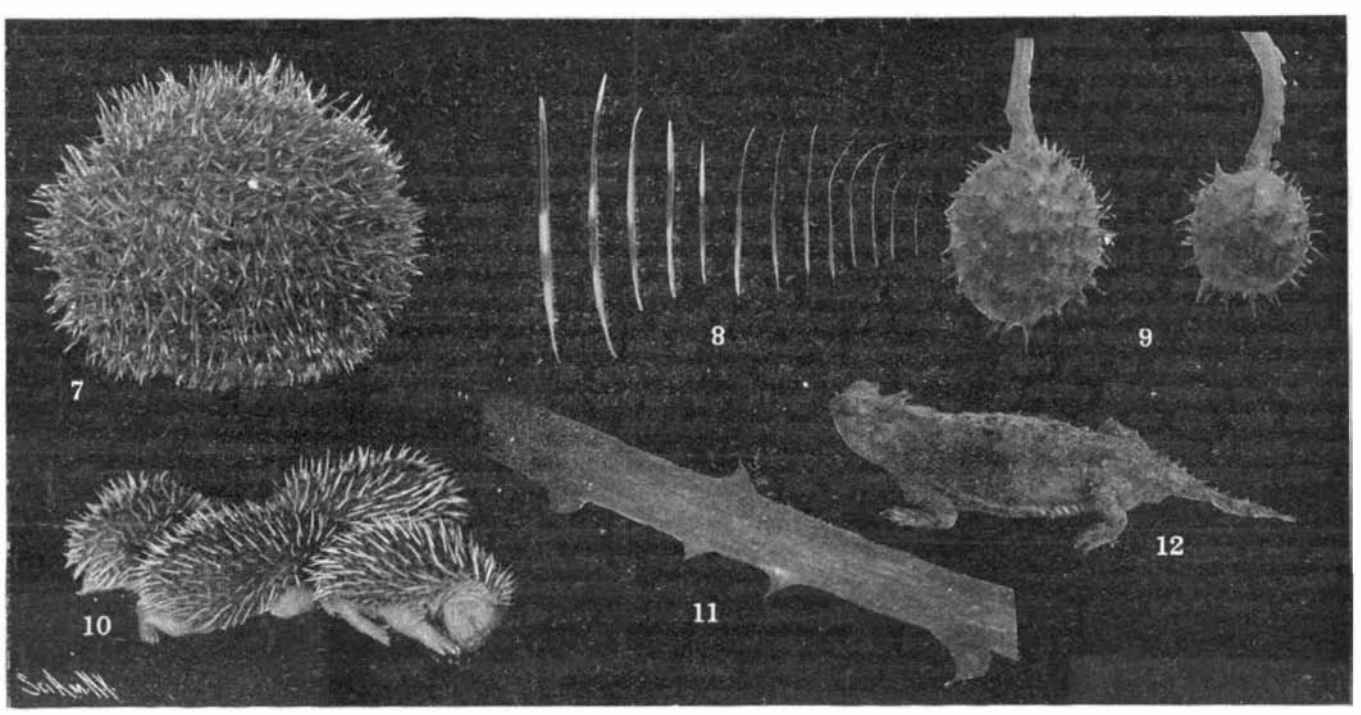
The cacti of Central America are, perhaps, the most interesting of all prickly plants. Here the sharp spines are to be regarded as the remains of departed leaves, although in the cacti the leaf functions are delegated to the swollen stalks, the spines being wholly protective.

We have all admired the beautiful flowers and have marveled at the quaint shapes of cacti, but to understand these plants it is necessary to call to mind the conditions under which they grow and flourish. Probably no plants have to contend with more adverse circumstances. Typical of the arid districts of Central America, cacti must keep green and fresh under a scorching sun through long periods of complete drought. This they manage to do by making themselves into what are really water-cisterns. A cactus is just a thick, juicy mass of green cells, storing sufficient water to enable it to flower and perpetuate its kind. But in a region where water is a luxury, its possession constitutes a real danger. The cacti have, as it were, "cornered" water, and have thus become objects of envy to thousands of thirsty creatures who would like to gnaw and suck and bite at their juicy stems. Such treatment would, of course, mean death to the cacti; and in order to protect themselves and their water from assault, they have acquired the formidable array of spines, and are thus able to flourish under conditions which would speedily annihilate almost all other kinds of vegetation.

Flowers are often protected by prickles, as in the case of the familiar thistle, or the teasel; while fruit capsules, such as those of the horse-chestnut and many exotic kinds, are also spiny. Did space permit, dozens of other instances of protective prickliness might be cited. The above examples, however, are sufficient to show how widely Nature has employed this particular means of defense.



1. Globe Fish Inflated for Protection. 2. Normal Form of Globe Fish. 3. Typical Spiny Shell. 4. Typical Cactus. 5. Teasel Heads. 6. Sea Urchin.



7. Rolled-up Hedgehog. 8. Porcupine Quills Developed from Ordinary Hair. 9. Prickly Fruit Capsules of Horse Chestnut. 10. Family of Baby Hedgehogs. 11. Thorn Bug; the First and Last Projections on Under Side of Branch Show the Bugs. 12. Horned Toad.

NATURE'S TOUCH-ME-NOTS.

More Prizes for Safety Devices.

An international competition is announced for the successful design of two safety appliances for the purpose of protecting work people by the Associazione degli Industriali d'Italia per Prevenire gli Infortuni del Lavoro. One concerns the electrical industry, a gold medal and $1,520 being offered for a means of eliminating the danger of a contact, no matter what resistance, between the primary and secondary circuits of alternating-current transformers and their respective lines. It must be of simple design, of substantial construction, economical as regards cost and maintenance, and must be easily adaptable to existing installations. It must come promptly into action whenever the potential to earth of the low-pressure circuit attains double the normal value in the case of a three-phase, and two and a half times the normal value of a single-phase system, while at the same time it must prevent any excess in potential becoming permanent. The working of an installation fitted with this safety device must not be rendered more difficult, such as putting the transformer out of action in the event of atmospheric discharges or of such partial reduction of insulation of service lines to earth as may be acceptable in practice. Competing devices will be tested upon a high-pressure circuit of 3,600 volts. The second award is in connection with the evolution of a hand crane or winch, in which any danger of the handle rotating during the descent of a load without any appreciable reduction in efficiency or speed of descent may be prevented. The device or system must be of simple and substantial construction, and not liable to excessive wear. The prize offered is a gold medal and $200. The competitor must supply a complete apparatus capable of submission to practical test. Application to compete must be received at the address of the association, 61 Foro Bonaparte, Milan, not later than June 30, 1908, where further particulars may be obtained.