SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
American Homes and Gardens ..... 3.00 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JULY 1, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AMERICAN HOMES AND GARDENS—THE NEW MAGAZINE.

The publishers of the SCIENTIFIC AMERICAN begin this week the publication of a new monthly illustrated magazine, entitled American Homes and Gardens. It is at once a new series of the SCIENTIFIC AMERICAN Building Monthly, and a new magazine of the home—new in idea, new in spirit, new in form, new in plan and execution.

American Homes and Gardens will speak of the home and to the home. In speaking of the home it will present in the highest type of modern illustration, pictures and views of houses, within and without, already completed and occupied. In speaking to the home it will address itself to home betterment, home improvement, home uplifting in so far as the house—the building—is concerned.

The architectural point of view which was developed in the SCIENTIFIC AMERICAN BUILDING MONTHLY will be broadened and expanded in AMERICAN HOMES AND GARDENS. Good building is the foundation of good home life, and it is this aspect of building which will be treated in every possible phase. The importance of the garden in home development is almost as great as that of the house; for the garden gives that outward touch of beauty which adds to the perfection of a well designed home. The house and the garden are, in fact, but two aspects of the home idea; and it is of these that AMERICAN HOMES AND GARDENS will treat.

The programme is a broad one and will be developed in the broadest possible way. Home betterment is related to many things which do not enter immediately into the problems of house construction or of garden design. If these matters may be called lesser it will not be because they are of minor importance, but because not being concerned with actual problems of brick and mortar, of wood and stone, they are not always classed with building problems. AMERICAN HOMES AND GARDENS is not a building magazine, but a journal of the home, an infinitely wider, broader, nobler theme, concerned with some of the weightiest problems before the American people.

The new magazine begins with the number for July, now ready on all news stands. A half dozen houses of real interest, and thoroughly illustrated, with interior views and plans, form the architectural contents of the number. There is an elaborate account by Barr Ferree of Mr. Eben D. Jordan's fine country seat, "The Rocks," at West Manchester, Mass. Harry Dillon Jones describes the successful experiments in manufacturing cement garden statuary by Mr. M. R. Mercer. Joy Wheeler Dow begins a notable series of papers on "Principles of Home Decoration." Alice M. Kellogg writes on "The Dining Room of the Past and the Present," and Charles F. Holder contributes an entertaining account of "The Spanish Missions in Texas and Arizona." Other articles include "Helps to Home Building," "Furnishing the House," "Science for the Home," "The Garden," "The Household," "Civic Betterment—The Kitchen," "New Books," and many valuable and practical notes on house building and equipment. The magazine is beautifully and copiously illustrated, and is the handsomest home magazine yet published.

ATMOSPHERIC CONDITIONS IN THE SUBWAY.

Much surprise has been expressed that the temperature of the Subway should have been so nearly equal to that of the street surface during the periods of hot weather that have recently visited this city. When on a hot day the suburban resident had occasion to enter the cellar of his frame cottage, he noticed the refreshing coolness of the air as soon as he had descended below ground level. He argued that the Subway, being entirely below the street, would be relatively as cool as or even cooler than his cellar. His expectations were strengthened by the fact that whenever he happened to enter the Subway during the closing weeks of its construction, he found that the interior atmosphere was particularly cool and refreshing. With the advent of the warm weather, these expectations have been cruelly disappointed, and it is a fact that at various times during the recent hot spell, especially after a sudden drop of temperature on the street, the Subway has been many degrees warmer than the street.

The explanation is not far to seek: It is to be found in the fact that the movements of the trains, and the abundant entrances at the stations, together cause a very thorough circulation of air, the cold air being driven out of the Subway, and warm air from the surface sucked in, with the result that temperatures on the street and in the Subway are soon equalized, and the expected cellar-like coolness is altogether wanting. Although these facts are pretty well understood by engineers, the general public has mistaken the high temperature for a lack of ventilation, interpreting the "stuffiness" as an indication that the Subway air is impure. As a matter of fact it can be safely said that the more nearly the temperature in the Subway approaches that of the street, the more thorough is the ventilation—the high temperature being the price we pay for the circulation of air. If the Subway, for some reason, were to remain unused for a week or two, with no trains running, no passengers on its platforms, and with the entrances closed up, the temperature would fall steadily until on the hottest days it would be found to be, between stations, a great many degrees cooler than at the surface.

There are, of course, secondary causes that add to the discomfort, such as the heat of the motors, of the electric lights, and that due to the presence of so many hundred thousands of people within the Subway, to say nothing of the effect of the glass-roofed stations. In connection with the last-named cause of discomfort, the question of the abolition of the glass-lighted roofs becomes a legitimate subject of discussion for the engineers who now have the question of Subway atmospheric conditions under consideration. The abolition of these lights would undoubtedly render the stations cooler in the hot weather, and the addition of a few arc lights would give all the necessary lighting.

A CITY OF TOWERS.

The announcement that one of the largest insurance companies, whose premises cover an entire block in the center of this city, is about to enlarge the capacity of its offices by the erection of a tower over 500 feet in height, suggests that in the coming years the skyline of New York city may be pierced by many such structures. That a tower of this height is not considered to be architecturally impossible of successful treatment, is suggested by the fact that in the plans submitted under the last administration for the erection at the Brooklyn Bridge terminus of a combined railroad station and department offices, the architect contemplated a tower building which was to be something over 600 feet in height. The statement has been frequently made that although there is no structural reason why buildings should not be carried up to a height of 500 feet or more, the area required for the elevator service would be so large, and would cut so deeply into the rentable floor space, as to render such a building commercially unprofitable. That question, however, would be determined by the relation of the area of the ground plan to the height of the building. In the case of the insurance company's building, above referred to, the ground plan of the tower is to measure 150 by 75 feet, a total of over 11,000 square feet. On a ground plan of these dimensions, it would be possible to establish an ample elevator service to the very top of the tower, without encroaching too heavily upon the rentable floor space. Of course, every one who is interested in the architectural appearance of this city deplores the exaggerated height of its buildings, many of which, even though they do not exceed 250 or 300 feet in height, are still, as regards the proportion of base to height, veritable towers. Unfortunately, in the earlier days of construction of such buildings, our architects made the fundamental mistake of trying to reduce their apparent height by accentuating the horizontal lines thereof. This was a radical error. What they should have done was to accept the situation, and endeavor to accentuate the vertical as against the horizontal lines, and honestly endeavor to make the buildings look the towers that they were. In one or two cases, in such buildings, this has been done with very happy effect, and it still remains for one of our less conservative men to take, let us say, one of the beautiful cathedral towers of Europe as a model, and by grouping the window spaces and accentuating the vertical lines, reproduce something of the effect of the great Gothic windows and other characteristic effects of these handsome structures.

The reasonableness of this suggestion is shown in the undeniably handsome effects produced by the Gothic treatment of the new Trinity building. If Gothic details can do so much to redeem the vast blank wall of this structure, what might it not have accomplished if applied to such a tower as the American Surety or the St. Paul building?

ARE FAST TRAINS DANGEROUS?

The fact that one of the new 18-hour trains to Chicago has been wrecked, with a long list of fatalities, and that immediately after the wreck the company reduced the speed to the former twenty-hour schedule, will naturally lead the general public to the belief that such trains are inherently dangerous. They will think so, in spite of the fact that in the official notification made by the president announcing the withdrawal of the train, it is expressly stated that such withdrawal is not to be taken to indicate that there are any physical dangers attending its operation. At the present writing, the evidence seems to point to the fact that the train was wrecked through the misplacing of a switch by some maliciously-disposed person, and if this was the case, the disaster is no more due to the high speed of the train than it would have been to that of a train running at one-half the speed. We will go further and say that the chances of the engine breaking through or jumping over a misplaced switch, and taking the main line again beyond it, would be greater in a fast than in a slow train.

The reducing of the schedule from eighteen hours to twenty is due to considerations, not of any engineering difficulties attending an eighteen-hour train as such, but to the popular prejudice which will inevitably consider the speed of the train and the accident in the relation of cause and effect.

Not only has the recent accident no bearing one way or the other on the safety of high-speed trains, but as a matter of fact a fast train such as this is, for several reasons, the safest one that a passenger can select out of the many trains that are at his service. This will be evident from the following considerations:

First. Because of the prestige which attaches to a "flyer" the company selects its very best rolling stock, and places at the head of the trains its most reliable engines, the master mechanic taking particular care that they shall be in perfect running condition.

Second. The train crew is specially selected, the enginemen and conductors being chosen on their records, and being in every case men of long experience on the divisions of the road which they have to cover.

Third. Since the eighteen-hour train represents the highest development of the constructive and operative departments of the railroad, it becomes an object of special pride and solicitude to every one on the system who is concerned directly or remotely in its successful running. It is given the right of way over all other trains. Switchmen, signalmen, station agents, the crews of other trains that it may overtake or meet, follow the movements of the "flyer" with close attention, watch for its coming, and in the earlier days of its running, give it God-speed as it flashes by. Whatever train may come to grief through forgetfulness (that fruitful source of train disasters), it is safe to say that your "eighteen-hour" trains, your "lightning expresses," "flyers," and what not, are not likely to be among the number.

Fourth. On the straight stretches of the line the fast train, because of its higher velocity, is less likely to be thrown from the track by some obstruction than the slow train. The writer was once on an engine that was thundering down grade, through the "Bad Lands" of Dakota, with a ten-car train behind it, at a speed of over sixty miles an hour, when the engine struck and swept through a band of wild horses, that dashed out of a neighboring canyon across the track just as the train was upon them. The engine and train kept the rails unharmed. At another time he was on an engine that was crawling slowly up grade, when a small band of sheep crossing the tracks proved enough to derail the engine. It takes but a very small force to deflect a billiard ball that is rolling slowly across a billiard table, but if that same ball were moving at the rate of 100 feet a second (a frequent speed for these fast expresses) it could only be deflected by the exercise of considerable force. It is the instinctive recognition of this fact that has led some engineers, when they have seen that they must hit a comparatively light obstruction, to increase rather than retard the speed of the train. Indeed, it is a matter of record that on one occasion the "Twentieth Century Limited" cut through a box car that had been thrown across the track immediately in front of it, with so little disturbance to the train that the passengers knew nothing of the occurrence. On a slow train, a derailment would have been almost certain.

Fifth. On moderate curves the danger of jumping the outside rail, even by the fastest trains, is practically eliminated by the superelevation of that rail. On sharper curves, where the running instructions call for a slowing down of the speed, the risk of derailment is, we think, less with the train having the fastest schedule than with the slower train. And this for the reason that while the engineer of the flyer knows that he must slow down in any case, the engineer of the local or slower train, not being accustomed to slacken speed at such and such curves, is liable, and often does, when he is late and making up time, negotiate these curves at a speed much higher than is allowed. During a ride which the writer took some years ago on an engine of

the "Twentieth Century Limited," he was impressed with the great care with which the enginemen slowed down on curves that exceeded a certain degree. During many years of observation of the action of trains on sharp curvature we have never known a fast express to run around curves at a speed exceeding the safe one, but we have many times seen such speed exceeded on slow and heavy trains that were endeavoring to make up time on down grades where the curvature was heavy.

Sixth. In the event of collision, the actual smashing effects, and therefore, the fatalities, are likely to be less in the fast than in the slow passenger train. The former will be made up of four or five cars, the latter of from eight to ten; and since the crushing in of the cars and wounding of the passengers is due to the total momentum of the train, all of which must be expended before the cars come to a state of rest, it follows that the wreckage of the ten-car train, moving at fifty miles an hour, would be far greater than that of the five-car train moving at sixty miles an hour—and this in spite of the fact that the momentum increases as the square of the velocity. In other words, it will require the crushing up of more cars to absorb the momentum of the slow heavy train than it will that of the light fast train. Had the misplaced switch been open in front of the slower nine-car "Lake-Shore Limited," for instance, the casualties would undoubtedly have been much heavier than they were in the present case.

Lastly, the fast train, like the fast transatlantic liner in a fog, is sooner through the danger space. This argument, which is accepted among steamship captains as a perfectly sound one, applies in its degree to railroad travel, for if dangers lurk on the rails, the sooner the journey is over, other things being equal (and we have shown above that "other things" rather favor the fast train than otherwise), the less the danger of injury.

We have gone somewhat fully into this question, because we believe that it affects, in the most vital way, the whole question of the increased speed of so-called express American railroad trains, which to-day, except for a few special trains, is lamentably behind that of some foreign countries. Every day of the year in France over thirty trains are run that have a schedule speed of from 55 to 60 miles an hour; and in Great Britain there are over fifty such trains. Time was when the immature state of our railroads could be urged as a plea for the low average speed of the majority of our express trains. No such plea can be urged to-day, for our best track is just as good as the best track in European countries.

THE HEAVENS IN JULY.

BY HENRY NORRIS RUSSELL, PH.D.

Two very interesting announcements have come from American observatories recently. One is from the Lowell Observatory, stating that photographs of Mars showing some of the canals have been secured there. This, if confirmed, will remove all question of the reality of these much discussed phenomena. The other is from Harvard and conveys the news that another satellite of Saturn has been discovered photographically by Prof. W. H. Pickering, raising the number to ten. It is an exceedingly faint object of about the 17th magnitude, even fainter than the ninth satellite, but in other respects it is quite unlike it or the two new satellites of Jupiter. Instead of being a distant attendant it is relatively close, having a period of about 21 days, which corresponds to a distance of about one million miles from the planet, and it revolves from west to east like the inner satellites and Saturn itself.

These values are very close to the corresponding numbers for the faintest of the old satellites, Hyperion, but Prof. Pickering's statement that Hyperion is visible on his photographs and is three magnitudes, or nearly twenty times, brighter than the new satellite disposes of all question as to their identity. It seems that here we have two satellites whose distances and periods are very nearly alike.

No such case has previously been known among satellite systems, but in the solar system the asteroids furnish an excellent analogy, for among them it is possible to pick out many pairs whose orbits are very nearly alike both in size and shape.

We may pursue the analogy further, for the new satellite is very small, probably not over 100 miles in diameter, while the largest of Saturn's satellites, Titan, has a diameter of about 3,500 miles, and the planet itself of 73,000, so that the new satellite is smaller in comparison to Titan than the latter in comparison to Saturn itself. Finally to complete the likeness, the orbits of the asteroids lie just *inside* that of Jupiter, which is much the largest of the planets, and the orbits of Hyperion and the new satellite lie just *outside* that of Titan, which is by far the largest of Saturn's satellites.

Is this remarkable similarity an accident or can we assign a reason for it? To answer this question we must enter for a moment into the realms of mathematical astronomy, where we have not to seek far for an explanation.

Every planet is attracted not only by the Sun but by all the other planets, and the closer together two of them are, the greater will be the attraction. If, therefore, two planets of considerable size had orbits which approached very near one another at any point, sooner or later they would both come near this point at the same time. Their mutual attraction would then be so great that it would alter the direction in which they moved, and after the encounter they would pursue quite different orbits from their previous ones. In certain cases the orbits might be so profoundly changed that one of the two might collide with the Sun, or be sent away into space never to return, as a result of the encounter.

Such things are liable to happen unless both the planets are very small so that their mutual attraction is insufficient to affect their motions perceptibly. We see, therefore, that the small size of the asteroids is a necessary condition for their *permanently* continuing to move in the orbits which they now possess.

But what does the neighborhood of Jupiter have to do with the existence of these small planets? Here we must go farther back into the probable history of the solar system. It is generally believed that the planets have condensed to their present forms out of much more sparsely distributed matter which perhaps once formed rings or something of that sort revolving about the Sun. Whether the parent matter of the asteroids formed a ring or not, it must have come much nearer to Jupiter than that of any of the other planets did. Now it can be shown that the attraction of Jupiter would tend to tear any such diffuse mass into separate bits. It seems therefore quite likely that the asteroids represent a planet "spoiled in the making," owing to the relative nearness of Jupiter, which prevented it from condensing into a single piece as the other planets, farther away from this disturbing influence, did.

Just the same reasoning will evidently apply in the case of the Saturnian system, where the planet takes the place of the Sun and Titan that of Jupiter. So we see that the likeness we have already mentioned is not a mere accident, but can be explained on gravitational principles.

It is tempting to extend the analogy still farther and to suggest that Hyperion and the new satellite may be only the brightest members of a group of Saturnian asteroids, but the extreme faintness of the newly-discovered object suggests that even if there are more still smaller ones they may be too faint to see or photograph.

THE HEAVENS.

Clear summer nights give us our best opportunities to became familiar with some of the brightest of the southern constellations. Scorpio, the finest of these, is on the meridian at 9 o'clock July 15, and in our latitude the whole constellation can be seen. It consists of a vertical line of three second-magnitude stars, then to the left another group of three, the central one of which is very bright and very red, and a long curving line running from these down almost to the horizon and bending back again to form the monster's tail. East of Scorpio is Sagittarius and above the two are Ophiuchus and Serpens. Above these again are Hercules and Corona. Lyra and Cygnus are farther east, near the Milky Way, and Aquila is south of them. Andromeda, Pegasus, and Capricornus are rising, but not conspicuous yet. West of the meridian the most prominent objects are Arcturus, Spica, and Mars, the latter the lowest of the three. Leo is settling in the west and Ursa Major is above and to the right of it. Draco and Ursa Minor are above the pole and Cepheus and Cassiopeia on the right.

THE PLANETS.

Mercury is evening star in Gemini, Cancer, and Leo. At first he is close to the sun and invisible but at the end of the month he can be well seen, as he sets at about 8:30 P. M.

Venus is morning star in Taurus. On the 6th she reaches her greatest elongation, being a little more than 45 deg. west of the sun. She rises about 2:30 A. M. and is the brightest thing in the morning sky. Mars is in Libra and is prominent in the evening sky, settling about midnight. Jupiter is morning star close to Venus. The closest conjunction occurs on the 4th when they are only 2½ deg. apart. Saturn is in Aquarius and rises at about 10 P. M. in the middle of the month.

Uranus is just past opposition, and is well observable. He is in Sagittarius, his position on the 15th being R. A. 18h. 6m., dec. 23 deg. 42 min. Neptune has just passed conjunction with the sun and is invisible.

THE MOON.

New moon occurs at 1 P. M. on the 2d, first quarter at 1 P. M. on the 9th, full moon at 11 A. M. on the 16th, last quarter at 8 A. M. on the 24th, and new moon once more at 11 P. M. on the 31st. The moon is nearest us on the 10th and farthest away on the 23d. She is in conjunction with Mercury on the 3d, Mars on the 11th, Saturn on the 19th, Jupiter on the 26th, and Venus on the 28th.

Cambridge University, England, June 13, 1905.

ENGINEERING NOTES.

Multiple screws were used as early as our civil war on some vessels known as "tin-clads" on the Mississippi, their adoption being necessitated by the shallow draft. Twin screws were first used in war vessels where the necessity for keeping the machinery below the deck would not allow of all the power being conveniently used on a single shaft, but the great advantage they possess of security against total disablement and for maneuvering soon made them the rule for all naval vessels large enough to admit of them. They were much longer in coming in the merchant service where the limitations on naval machinery do not obtain, but since the era of the very large transatlantic steamers beginning with the "Paris" and "New York," and the "Teutonic" and "Majestic," all very large vessels have been built with twin screws.

In the early steamers, almost the only independent steam auxiliary was a single pump which could be used for feeding the boilers while under banked fires or with the engine stopped, and for pumping the bilge. The other pumps were attached to the main engine. Such things as steam capstans and winches, steam steering gear, distilling apparatus, evaporators, forced draft blowers, and electric light engines, were not dreamed of. As time went on and the size of vessels increased, steam capstans and winches and steam steering engines came in. Then it began to be found desirable, particularly for naval engines, to remove all the pumps from the main engine, leaving it nothing to do but turn the propeller, and this brought about independent air and circulating pumps and feed pumps. Further progress introduced the distiller and evaporator, the forced-draft blowers, and the electric light engine.

Submarine boats made a brilliant performance at the recent maneuvers which the French navy carried out in the bay of Toulon. This is the first time that such maneuvers have been held in France. The idea was to combine the operations of the submarines of the port with the torpedo boats which form part of the defending fleet. The operation was as follows: A polygon had been traced in the great harbor. This polygon, which had a surface of some 3,000 square yards, was formed on one side by the shore and on the others by imaginary lines which had been determined in advance. A squadron composed of six torpedo boats of the fleet, headed by the destroyer "La Dragonne," was detailed to defend and keep a lookout upon the polygon. On the other hand, five submarines were to traverse the space from one end to the other, without being seen or localized by the torpedo boats. The maneuver took place during the forenoon. It proved to be of a most instructive character, and gave some very conclusive results as to the operation of the submarines. The torpedo boats, which had an entire freedom of movement, ranged themselves at the extremity of the polygon, and facing the shore, on a line parallel to the latter, so as to have a wide field of vision before them. The sea was remarkably calm and exceptionally transparent at that time, which gave the least favorable conditions for the submarines. Besides, these small craft are the oldest of the series and the first to be built, so that they had not the benefit of the great improvements which have been recently made. The "Zédé," the "Gymnote," and three other submarines of the same type were ranged in line. In spite of the clearness of the water, the freedom of movement of the torpedo boats, and the sharp lookout which the officers and crew kept up in order to note the smallest disturbance at the surface, the five submarines were able to traverse the whole width of the polygon and were quite invisible, and no one was able to reveal their presence or to say at what time they had passed across the space. Only one of the torpedo boats, the No. 140, in the report which it presented to the commandant of the defense, stated that during a few seconds a slight bubbling was noted, this no doubt being caused at the surface of the sea by a periscope which came near the top, but the duration of the disturbance was so short that no exercise of sighting could be made, and in spite of the efforts which were made at once, it was quite impossible to discover the path of any of the submarines. The naval authorities here consider that this experiment which is tried for the first time with the torpedo boats and submarines, is among the most important and conclusive, and justifies the confidence which the navy has in the good performance of the submarines.

The railway companies in Switzerland have determined that for the future all children under 2 feet 1 inch in height will be passed at half fare, and those above, whatever their ages may be, will be treated exactly as adults. At each station, near the booking-office, a measuring machine is to be fixed, and whenever a child applies for a half-fare ticket it will be invited to stand under the scale.