of work. In 1903 the total Southern cotton crop amounted to 10,205,073 bales, which was only a slight increase over the average for the past five years. To gather such a crop within the harvesting season of 130 days, it would therefore require 1,088,000 laborers if each one picked his quota of 100 pounds of seed cotton per day. The cost of paying this army of pickers at current market wages in the South would amount to more than 10 per cent of the total value of the whole crop. According to statistics last year the amount paid for picking the crop approximated $70,750,000.

What other crop in the country requires such enormous expenditures for gathering? Not even the tea crop of China and India, where picking is done entirely by hand, equals this stupendous item. The tobacco and sugar-cane crop likewise must be gathered by hand, and no adequate machinery for harvesting them has yet been invented; but in their case nothing like 10 per cent of the total valuation of the crop is expended in the harvesting.

Cotton production is thus limited chiefly by this absence of mechanical appliances for harvesting. Prior to the invention of the cotton gin, the culture of cotton was restricted in the same manner as it is to-day; but immediately after this invention the expansion of the industry was noteworthy. Almost within a decade the industry rose from almost nothing to the leading one of the South. It is not too much to expect that the discovery of a successful cotton-picking machine would almost immediately extend cotton culture so greatly that the world's supply would be doubled, and the price reduced nearly one-half, while the growers would enjoy a degree of prosperity not experienced by them for years.

There have been numerous attempts to invent cotton-picking machines; but all of them have revealed such defects in practical operation that they have not been generally adopted by the growers. Yet it is not clear to inventors that these difficulties are of an insurmountable nature.

Prior to the invention of machinery for extracting cotton-seed oil from the waste cotton-seed, the profits to the growers were far less than at any time in the history of the industry. The cotton-seed compressor and extractor almost immediately gave to the waste product of the cotton farm a new value, which has steadily increased ever since. The cotton-seed oil has been found of use as a substitute for olive oil, linseed oil, lard and even for some illuminating oils. To-day there are over seventy-five crude oil mills engaged in handling cotton-seed oil; nearly eighteen refineries; fifteen cotton ginneries; five mammoth cotton-seed oil compressors; ten soap factories; five cottolene and lard factories, and several fertilizer mixing plants, all dependent upon the cotton-seed for their raw material. The various articles manufactured from the oil or the seed-oil cakes used for fertilizers aggregate a value of over twenty millions of dollars a year.

The utilization of a by-product that creates industries valued at millions of dollars is one of the highest achievements of modern invention of machinery. Agricultural machinery invented for simplifying the work of planting, cultivating, and harvesting of crops has added more to the wealth of the country than all other classes of machinery. The planters, cultivators, and harvesters have doubled and tripled the yield of wheat a dozen times over. The American crop of cereals could not be garnered by hand to-day without enlisting the continuous service of ten million laborers during a good part of the summer and autumn seasons. Fully a seventh of the population of the country would thus be required to gather the grain crop, and the other six-sevenths would probably be needed in doing the other agricultural labors of the country, leaving no one to attend to the manufacturing and commercial pursuits.

Hundreds of millions of dollars are invested in the manufacture of harvesting, planting, and cultivating machinery and implements, and they enable the American farmer to secure more from an acre of land at less cost than he could possibly do without machinery. While intensive farming in the United States has never reached the same development as in parts of Europe, the use of improved agricultural and labor-saving machinery for harvesting and cultivating crops has been carried to a much higher point of efficiency than elsewhere on the globe. It is doubtful if the American farms could much more than feed our own population without modern machinery, and our exports of farm products would immediately cease.

In the future of cotton raising the introduction of machinery for harvesting the crop can alone transform present conditions and increase the present output to any great extent. With the high cost of picking threatening them, the southern cotton growers refuse to increase their acreage beyond a point where they can safely count upon getting the cotton harvested within the limited fall season.

The few cotton-picking machines that have been invented have invariably proved inadequate. To do the work rapidly and thoroughly the machinery must be delicate and almost human in its operation. The fiber of the cotton plant is the wing of the seed, and it is soft and fleecy, ready to be blown away by the wind. To pick this fiber requires expert manipulation of hands that can separate it from the boll without injuring the fiber itself. The gathering of the cotton from the boll with the fingers is not difficult, but to invent machinery to do this is complicated.

Modern improvements of cotton by cultivation and selection have lengthened the staple, and made picking far easier, introducing conditions more favorable for machine harvesters. Thus through plant breeding and selection sea-island cotton of our Southern States has been raised from a common wild plant that seldom matured its seeds, and with a staple less than one inch in length, to handsome plants with fiber from two to three inches in length, and strong and fine as silk. In fact, the finest grades of the improved sea-island cotton plants are used to adulterate silks, and the price they bring in the market is double that paid for the ordinary grades. The influence of breeding and cultivation in making longer fibers has also increased the yield. Some of the heavier grades have been made nearly to double their annual yield, and the amount raised per acre is thus increased.

Thus the cotton problem becomes a mechanical more than an agricultural question. The growers have almost reached the limit of improvement, and science has nearly exhausted methods for increasing the yield chemically and culturally; but the inventor's field is still unexploited, and is waiting for the genius to come and claim a rich reward.—George Ethelbert Walsh.

THE HEAVENS IN AUGUST.

BY HENRY NORRIS RUSSELL, PH.D.

The summer constellations are now well visible, and this is a good month in which to learn to know them.

If we go out at nine o'clock on a clear evening in the middle of August we will see the Milky Way, forming a great arch across the sky and passing almost overhead. Many of the finest constellations in sight lie near it, and we will begin with them.

Near the horizon, a little west of south, is Scorpio, the most brilliant of the twelve zodiacal constellations. Its brightest star, Antares, is fiery red in color, and is accounted the reddest of all the bright stars. A fainter white star flanks it on each side. The vertical row of three stars on the right makes the Scorpion's head and claws, while its tail is formed by the long line of stars which descends from Antares almost to the horizon, and curves back to the end in a bright group, which is conspicuous even at the low altitude at which we see it.

Antares is doubly worthy of attention by those who possess telescopes, as in addition to its splendid color and fine banded spectrum, it is double, having a green companion of the seventh magnitude at a distance of about three seconds. On account of its nearness to the principal star, it can be well seen only when the air is steady.

To the left of Scorpio lies Sagittarius, whose principal configuration is the little inverted "Milk Dipper," composed of five fairly bright stars. Above it the Milky Way is full of bright patches and knots, which afford many fine telescopic fields. Some of the star clusters and nebulæ in this region are distinctly visible in a field-glass.

The bright star higher up, almost on the central line of the Milky Way, is Altair in Aquila. It is one of the nearest of the brighter stars, coming next to Sirius and Procyon in order of distance. The next constellation to the north of Aquila is Cygnus, which is easily identified by the fine cross of stars whose axis lies along the Galaxy. West of Cygnus, and almost overhead, is Lyra, whose principal star, Vega, is the brightest in this part of the sky. The region east of the Milky Way is not so brilliant. The most prominent group is the great square of Pegasus, which is now about an hour high in the east. The constellation is a large one, and extends westward from the square half way to Altair, leaving room between them for the little group of Delphinus.

Aquarius and Capricornus, which are lower down in the southeast, have no very bright stars, but Saturn, which is now in the latter constellation, is decidedly conspicuous. The brightest star in the western sky is Arcturus, which is almost due west, and about half way down to the horizon. The rest of Boötes lies north and east of it. A line from Arcturus to Vega passes first through the semicircle of Corona Borealis, and then through the keystone-shaped figure which is the most recognizable feature of Hercules, whose other stars extend some distance both north and south. Farther down between Hercules, Aquila, Scorpio, and Boötes a large space is filled by Ophiucus and Serpens—two constellations which are so inextricably confused that one must use a star-map to tell which stars belong to each.

Of the circumpolar constellations Ursa Major is in the northwest, to the left of the pole. The fore-parts of the Bear are too low to be well seen, but the Dipper is still conspicuous.

Draco lies above Ursa Major, extending to the meridian. The Dragon's head is marked by a conspicuous group of four stars about one-third of the way from Vega toward the Dipper. His body extends first eastward, then northward, and then bends back in a long curve, inclosing the Little Bear, so that the end of his tail lies between the Pointers and the Pole Star.

Cassiopeia and Cepheus lie in the Milky Way on the other side of the Pole, and Andromeda and Perseus are rising in the northeast.

THE PLANETS.

Mercury is evening star throughout August, and is visible in the evening twilight for most of the month. On the 1st he is close to the bright star Regulus. The two set at about 8 P. M., so they will not be easy to see. Later on the planet is more easily visible. He reaches his greatest elongation on the 19th, when he is more than 27 deg. from the sun—about as far as he ever can be, as seen from the earth. He is, however, some 10 deg. farther south than the sun, and is consequently not as conspicuous as he was in the spring. But as he sets an hour later than the sun all through the middle of the month, he ought to be seen without much difficulty. Venus is also morning star, but is still too near the sun to be visible to the naked eye.

Mars is morning star in Gemini and rises about two hours before the sun. On the 12th he is nearly in line with the two bright stars, Castor and Pollux, which may aid in finding him.

Jupiter is in Pisces and will soon be conspicuous in the evening sky. He rises before 10 P. M. on the 15th, and is well observable after midnight. Transits of his satellites may be seen on the nights of the 2d, 7th, 9th, 14th, 16th, 18th, 23d, 25th, and 30th.

Saturn is in opposition on the 10th, and is visible all night long. He is better placed for observation than he has been for several years, though he is still a good way south of the equator. He is in Capricornus, a long distance from any bright star, so that he can hardly be mistaken for anything else.

His rings are seen more nearly edgewise than in the last few years, and consequently appear narrower, so that the ball of the planet projects conspicuously beyond them at each side. The apparent orbits of his satellites are also becoming narrower, for the same reason. The fainter of these interesting bodies can only be seen with large telescopes, but the brightest one, Titan, is easily visible with a small instrument. It may aid in identifying him to know that he is north of the planet on the 3d, east on the 7th, south on the 11th, and west on the 15th, the positions repeating themselves regularly in the satellite's period of 16 days.

When north or south of Saturn his apparent distance from the planet is about equal to the greatest diameter of the rings, but when east or west of him it is about four times as great.

Uranus is evening star in Sagittarius. His position on the 15th is R. A. 17 h. 43 m., dec. 23 deg. 36 min. south. He is not near any conspicuous star, but if his place is plotted on a star-map, he can easily be found.

Neptune is morning star in Gemini, and rises at about 2 A. M. in the middle of the month.

THE MOON.

Last quarter occurs at 9 A. M. on the 4th, new moon at 8 A. M. on the 11th, first quarter at 11 P. M. on the 17th, and full moon at 8 P. M. on the 25th. The moon is nearest us on the 12th and farthest away on the 26th. She is in conjunction with Jupiter on the 3d, Neptune on the 8th, Mars on the 9th, Venus on the 12th, Mercury on the 13th, Uranus on the 20th, Saturn on the 24th, and Jupiter again on the 30th. None of the visible conjunctions is close.

An occultation of the fourth-magnitude star Gamma Tauri, which takes place early on the morning of the 6th, is visible in the eastern part of the United States. As seen from Washington, the star disappears behind the moon's bright limb at 1.56 A. M. and reappears from behind the dark limb at 2.55.

The times of the phenomena will vary for different places, being in general earlier for places farther west.

Cambridge, England.

The Michigan Central Railroad officials have for some time been considering the proposition of bridging the Detroit River at Detroit, Mich., but it is said that there is a strong possibility that these plans will be entirely abandoned, and the crossing effected by tunnel. Representatives of the company have been investigating the tunnel work around New York, and a careful examination of the Detroit River bed is now being made; and if the reports are as favorable as anticipated, the work will probably be commenced at an early date. The work is authorized by charters which have already been secured from the United States and Canadian governments. It is said that the tunnel route has many excellent features to recommend it.