changes that it shuts up its petals in the damp air which precedes rain, and is widely relied upon, before all other weather signs, by the British plowman. This peculiarity is also possessed by other common wild flowers, such as the wood anemone, or wind flower, the chickweed, convolvulus, and gentian. The burnet saxifrage and the chickweed even go so far as to half open their flowers again if the rain is soon to cease. The African marigold, which closes its petals regularly at nightfall, fails to reopen them in the morning if the weather is damp.

Not only the flowers, but also the leaves of some plants, give warnings of approaching change. Pliny states that the clover bristles and erects its leaves before a storm; and Virgil has described the signs of coming weather given by the leaves of the almond tree. The wild licorice plant (*Abrus precatorius*), the so-called weather plant, is said to hang its leaves horizontally for a change, upward for fine weather, and drooping for rain. This fact was called attention to in 1892; but the Kew observers who have specially studied it say the only movements discernible are due to the direct agency of light, heat, and moisture. In the United States it is a common saying that the leaves of the sugar maple turn upside down before a storm, while the silver maple shows the white lining of its leaf. In our own country, the wood sorrel, lime, poplar, sycamore, and plane trees vary the direction of their leaves with different conditions of the atmosphere.

The well-known saying which attempts to determine the weather of the coming summer by the priority of the oak or ash in the development of leaf buds has probably no more foundation in fact than belongs to the natural characteristics of these trees. In this country the oak is usually in leaf before the ash, and in so moist a climate the early summer is more often wet than dry.

According to modern meteorology, the greater part

WILLY BURMESTER.

WILLY BURMESTER AND ALEXANDER PETSCHNIKOW.

WE publish herewith portraits (for which we are indebted to the *Illustrirte Zeitung*) of Willy Burmester and Alexander Petschnikow, two violinists who are attracting the attention of the German concert world. When the former made his debut in Leipzig he created a great furor, and the latter caused a decided sensation when he appeared in Berlin and Leipzig last fall; he had already become known in his own country and in Paris.

Willy Burmester was born in Hamburg, and when he first left the Joachim school he struck into paths of his own in which he soon gained a reputation as a brilliant virtuoso who seemed to give promise of a decided and energetic individuality. His talent is remarkably versatile, and, consequently, his repertoire includes music of every variety. "If anyone should undertake to write a history of the violin virtuosi of Germany, one chapter would have to be devoted to 'Burmester,'" so says our German cotemporary.

It is only lately that the Russian violinist, Alexander Petschnikow, has appeared in Germany as Burmester's rival in the contest for the palm of fame. Petschnikow, the son of a simple Russian soldier, was born December 27, 1872, Russian style (January 8, 1873) at Jeletz, in the government of Orel, Russia. Mr. Solotareno, of the Imperial Opera Orchestra, discovered the talent slumbering in the fair haired boy of ten and put him in a way to have it cultivated at the Moscow Conservatory. He took the first prize before leaving this institution, and as a reward for his diligence his teacher procured for him the loan of a very fine violin that had formerly belonged to the celebrated Laub. Later some of his patrons helped him to become the owner of this highly prized violin, which helped him to wonderful success on his musical tours. His technique is most perfect. His name will always be

ALEXANDER PETSCHNIKOW.

of the storms which traverse these islands are of the cyclonic type, in which there is always a well-defined distribution of atmospheric temperature and pressure. The front of an advancing cyclone is marked by a damp, muggy atmosphere, with a general depressing effect upon the nervous system of man himself. It is not surprising that the lower animals should feel it also. The heaviness of the air renders the scent of flowers, and other odors, more apparent, and explains the habit of sniffing the air displayed by many animals before a storm. The excessive dampness of the atmosphere, by its influence on cutaneous perspiration, accounts for much of the restlessness and feeling of discomfort which so many of the fur and feather tribe betray during the passage of a cyclone across our islands. The animal skin, and also its appendages, are peculiarly affected by the humidity of the air. The Zuni Indians of New Mexico were wont to predict rain from the appearance of the scalp locks captured from their enemies. The fur of animals, the moist skins of toads and frogs, and the plumage of birds are very sensitive to small variations in the hygrometric state of the atmosphere.

Dampness has also a marked effect upon many vegetable tissues. If a beard of wild oat is fixed upon a stand, it twists itself up more or less according to the amount of water vapor present in the atmosphere. Pine cones can be used in a similar manner as natural hygrometers, closing up their scales in damp weather, and expanding them when the air is dry. The leaf stalks of plants are softened by damp, causing the leaves to droop or hang unnaturally. The sensitive plant *mimosa* exhibits increased irritability in the warm, moist air of a cyclone front; and even the downy hairs of dandelions, thistles, and colts' foot contract and expand under the ever varying influence of atmospheric vapor.

Here then is the explanation of the movements of plants described above. The plowman's weather glass need lose none of its efficiency because its mysterious sensibility is thus accounted for; it tells us actual conditions, which, rightly understood, may be capable of interpretation as signifying changes to come.

After the cyclone front has passed away, the air becomes dry and bracing, and a feeling of exhilaration pervades the whole of creation. Sea birds fly out far to seaward, rooks and kites soar aloft in the air, insects float in the light breeze in search of honey dew, and plants expand their leaves boldly to the sun. The confidence of all nature is restored, for the dangers of the storm are over.—Chambers's Journal.

one of the most prominent in the lists of violinists of his time.

GROWTH OF POPULATION OF GREAT CITIES.*

By ELMER LAWRENCE CORTHELL, D.Sc.

IN 1886 and 1887 Mr. Rudolph Hering, civil engineer, and at that time chairman of a commission for solving the problem of water supply and drainage of the city of Chicago, compiled some statistics and made a diagram showing the curve of growth of population of several cities in the United States. About the year 1890, for the purpose of presenting in a professional report on a rapid transit question in Chicago a comparison between the several cities shown on Mr. Hering's diagram, the writer extended the diagram to a more recent date. During the last year he has, by an extended correspondence, obtained the necessary information and has plotted on a new diagram the curves of growth of population of several cities of the world numbering over 1,000,000 inhabitants at the present time. These curves have been extended both backward and forward, as will be seen by an examination of the diagram. Many interesting and instructive features are presented by this comparison, and the value of the results thus presented graphically will be at once appreciated by an examination of the diagram.

The editor of *London Engineering* (to which this paper is primarily contributed and by which it is now being published) suggested to the writer during the investigations that it would be still further instructive and interesting as well to ascertain and give graphically the comparison of density of population. This has been done as far as it is possible to obtain the information. The squares showing these densities are from the latest census in each case and may be considered the present density.

The information has been obtained from official sources through the following correspondents, all of whom kindly interested themselves to comply with the author's requests for data and to whom he is largely indebted for the reliable character of the figures:

Mr. James Forrest, Secretary, Institution of Civil Engineers, London, England; Mr. C. O. Gleim, C.E., Corresponding Member of the American Society of Civil Engineers, Hamburg, Germany; Mr. Ernest

* From the proceedings of the American Association for the Advancement of Science, vol. XLV, 1895.

Pontzen, C.E., also Corresponding Member of the American Society of Civil Engineers, Paris, France; Hon. Clifton R. Breckenridge, United States Minister to Russia, and Lieut. Henry I. Allen, naval attaché of the United States Legation, St. Petersburg, Russia; Hon. Chas. Denby, United States Minister to China, Peking; Mr. John C. Trautwine and others in the United States.

As each city has its peculiarities in history, growth, density and many other features, it is necessary to take up each separately in order that the reader may fully understand and appreciate the curves on the diagrams.

LONDON.

For the information of our readers who are not familiar with the peculiar geographical conditions of the population, the following data need to be given in order to have a full understanding of the subject.

London within various boundaries:

	Area in statute acres.
Within the registrar-general's tables of mortality.....	74,672
Within the limits of the county of London.....	75,442
London school board district.....	75,442
City of London within the municipal and parliamentary limits.....	671
Central criminal court district.....	269,140
Metropolitan parliamentary boroughs (exclusive of the City of London).....	74,771
Same (including the City of London).....	85,442
Metropolitan police district (not including the City of London).....	442,750
Metropolitan and city police districts.....	443,421

The metropolitan police district extends over a radius of fifteen miles from Charing Cross—688.31 square miles—exclusive of the City of London.

The population used in the curve of growth is that included in the registrar-general's area. It is almost impossible in the case of London, as well as that of other cities, to define the area of the metropolitan population, that is, the population of the city itself and of the suburban districts which contain the population doing business in the city. The limits of London could be extended far beyond those of the registrar-general, and with each extension a much different population would be found to exist. To compare, perhaps, more favorably with the other cities and cover the metropolitan area, it seems proper to state that the population supplied by the London water companies in 1892 was estimated to be 5,490,780, and this population is plotted on the diagram. In 1891 the population of "Greater London," if we include the "outer ring," was 5,633,806.

As to density of population, that of the White-chapel district is taken as a maximum, being on the 357 acres included, at the rate of 132,000 per square mile. The average in the whole of London is 37,000 per square mile.

NEW YORK.

The curve of this great city of the United States is interesting, first, by its comparison with its neighbor Philadelphia. The curves show that they kept pace with each other very closely from the year 1700 to 1830, when population in New York began to grow with rapid strides and has continued to do so up to the present time, the ratio of increase being greater than that of any other large city in the world except Chicago and Berlin. The density of the tenth ward, which is on the east side of the city between the Brooklyn Bridge and Grand Street is greatest of any in the world, with the exception, perhaps of a certain district in the city of Prague, and it may be said advisedly that sanitary district A, of the eleventh ward, has the greatest density of any corresponding area of the world, and twice that of Prague in 1893. It comprises about 320 acres and the density ranges from 600 to 1,000 inhabitants per acre, or an average of about 512,000 per square mile; the greatest density being 640,000 per square mile.

PARIS.

In 1860 the area of Paris was considerably extended by taking in the suburban communes, which increased the population at that time nearly half a million. The density of the population is shown, first, by taking out the squares, or greens and woods, making the average on this basis, 121,300 per square mile and the area 22.4 square miles. The average of the entire city, including the squares, etc., is 79,500 per square mile, covering 31 square miles. The curve of growth of Paris brings out several interesting and important historical points. For instance, the city, as is well known, suffered greatly during the latter part of the reign of Louis XVI and during the reign of terror, from 1774 to 1799, during which period the population actually decreased. On the other hand, under the reign of Louis XIV, 1643 to 1715, and that of Louis XV, 1715 to 1754, it greatly prospered and the growth in the latter period is shown on the curve as having a regular increase. From 1852 to 1870 the Emperor Louis Napoleon did much for Paris and its growth was very rapid and comparatively uniform. The effect upon the city by the Franco-Prussian war and the Communes is shown plainly on the curve of growth.

CHICAGO.

This city, on account of its large area in comparison with the population, has an average of only 6,430 inhabitants to the square mile, its area being 186 square miles. In arriving at the population for 1894, it is necessary to use considerable judgment in deciding which census should be employed. There have been estimates made of over 2,000,000, but to be conservative the school census of 1894 is used, making the population, including the whole of Cook County, 1,692,727. In ascertaining the ratio of increase, different results are obtained by using different methods of estimating the population, whether by the United States census or by that of the city. The increase from 1880 to 1890 by the United States census was 118 per cent. Comparing the United States census of 1890 with the school census of 1890, the ratio of increase per decade is 106 per cent. If, again, we compare the school census of 1884 with the school census of 1894, we have an increase of 150 per cent. per decade.

BERLIN.

The census of this city is taken every year and has

been so taken since the year 1720. Consequently, the curve of growth is an entirely different one from that of almost any other city, as the points in drawing the curve are much nearer together on the diagram. As in the city of Paris diagram, so in that of Berlin, the effects of political and military disturbance in the kingdom are plainly seen. The seven years' war from 1756 to 1763 caused a decrease in the population. From 1800 to 1810, an entire decade, there is again a steady decrease, and it was during this period that the battles of Hohenlinden, Jena, Auerstadt, Eylau and Friedland were fought with the French. By the peace of Tilsit at the end of this period Prussia lost one-half of her possessions and kept the other half under very hard conditions. In 1871 the King of Prussia was proclaimed Emperor of Germany and Berlin became the seat of the empire. From that time to the present the growth has been very rapid, the ratio of increase from 1883 to 1893 being 37 per cent.

In density Berlin stands next to Paris, the maximum density being 92,600 per square mile and the average density 67,612, with an area of 24.3 square miles.

VIENNA.

The accessible records of population of this city are very incomplete and the curve of population is made from a comparatively few dates. The authorities differ considerably as to the population. The fact that the garrison of the city is constantly changing vitiates the census records.

PHILADELPHIA.

There is nothing particularly striking in regard to the curve of this city. It shows a gradual growth and very regular. The density of population is very nearly like that of Chicago, being 8,091 per square mile on an area of 129 square miles.

ST. PETERSBURG.

The effect of the founder, Peter the Great, upon the

As the number of houses and the number of inhabitants per house have much to do with the density of population, the following items are of considerable interest: New York has 150,000 houses, averaging eighteen residents. London has 600,000 houses, averaging seven residents; at the beginning of this century it had only 130,000 houses. Paris has 90,000 houses; at the close of the Franco-Prussian war it had 70,000 and at the close of the Napoleonic wars it had only 23,000. The average number of residents in a Paris house is twenty-five, forty per cent. greater than in New York. The most of the public and office buildings in Paris are utilized for residence purposes, whereas in New York most of the buildings in the down town district are used entirely for business purposes. Taking a square mile of territory between Wall and Spruce Streets and between Broadway and the East River there was at a recent election only 430 voters, representing a total population of about 1750. The unoccupied spaces in parks, gardens and lawns in Philadelphia is seen from the fact that while its population is only about 1,000,000, it has 187,000 houses.

The facts on the diagram offer material for interesting study; such as the influence of national life upon urban growth, especially upon that of these principal cities; the serious effect of war upon the growth of cities; the remarkable change going on in these countries by which the great cities are pushing upward their curves of growth; and, what is perhaps of greater interest still, the quite close approximation that it is possible to make of the time when some of the curves will intersect and the rank in population be changed, some outstripping others and some falling behind their more prosperous competitors.

An approximate estimate may at last be hazarded, predicting the population of the cities under consideration at the end of future decades.

Certain important possible changes in conditions need, however, to be considered in forecasting such results, among which are, first, the changes which new

rest a prediction of population, which the author has the temerity to make as follows:

FORECAST OF POPULATION.

City.	Estimated population in 1900	Estimated population in 1910	Estimated population in 1920
Greater London.....	6,496,000	7,490,400	8,516,256
London.....	4,589,800	4,967,784	5,315,528
New York.....	3,300,000	4,953,000	6,191,250
Paris.....	2,697,300	2,967,030	3,234,063
Berlin.....	2,101,400	2,731,820	3,496,729
Chicago.....	2,400,000	4,540,000	8,208,000
Philadelphia.....	1,414,500	1,697,400	2,002,932
St. Petersburg.....	1,185,600	1,329,728	1,500,495

SELECTED FORMULÆ.

A Chemical Blotting Pad.—A cheap and excellent substitute for blotting paper may be extemporized as follows: Mix fourteen parts (by weight) of gypsum and two of potato flour, with sufficient water to produce a plastic paste. Pour or press into a suitable mould. As soon as the mass has become hard and dry, it affords an admirable blotter.

Maple Sirup Substitute.—A farmer is accredited with the discovery of this maple sugar substitute. In his endeavors to render corn cobs utilisable for fodder he found that continued boiling developed a sweetish taste reminding of maple sirup, and he now produces a fictitious article, according to the newspapers, in the following manner: Twelve clean cobs were put in a gallon of water and boiled until soft. Then the juice was strained off and a gallon of dark brown sugar solution added. This was boiled a little while, resulting in a fine quality of sirup hardly distinguishable from the maple product.

How to Transfer Newspaper Pictures.—The liquid to be used is made by dissolving one and one-half drachms common yellow soap in one pint of hot water, adding when nearly cold three and one-fourth fluid ounces spirit of turpentine, and shaking thoroughly together. This fluid is applied liberally to the surface of the printed matter with a soft brush or sponge (being careful not to smear the ink, which soon becomes softened), and allowed to soak for a few minutes; then well damp the plain paper on which the transfer is to be made, place it upon the engraving and subject the whole to moderate pressure for about one minute. On separating them, a reversed transfer will be found on the paper.—Allentown (Pa.) National Educator.

Snuffs for Hay Fever, Cold in the Head, etc.—The following formulæ are taken from the Amer. Med. Chir. Bulletin:

1. Cocaine hydrochlorate..... 18 gramme.
Morphine sulphate..... 8.3 "
Bismuth subnitrate..... 30.0 "
2. Cocaine hydrochlorate..... 1.8 "
Camphor..... 4.0 "
Bismuth subnitrate..... 30.0 "
3. Boric acid..... 20.0 "
Salol..... 6.0 "
Menthol..... 0.25 "
Cocaine hydrochlorate..... 0.06 "

Disinfection of Instruments.—(1) Sterilize coarse building sand by roasting. Fill a suitable vessel with this, and pour in a corrosive sublimate solution 4 per cent., or lysol 50 per cent., till the sand is thoroughly soaked; keep covered with a sterilized piece of pasteboard, pass all instruments through this three or four times—offers simplicity, rapidity, absolute sterility, no injury to instruments.—Dr. A. W. Harlan. (2) A 10 per cent. solution of boroglycerine in water will sterilize forceps, broaches, and cutting instruments and leave them without unpleasant odor.—Southern Dental Journal.

A Novel Magnesium Light.—Magnesium powder is placed between two thin impenetrable sheets of paper which are coated with paste. They are then stuck together. After drying, a sheet of paper impregnated with potassium chlorate is placed on each side of the package. For an envelope a wider sheet of paper is pasted about the packet, so that the whole forms a thick leaf of paper, which can be cut with a scissors into strips. To produce the light one of the strips is held in a tongs and ignited, when it burns with a brilliant magnesium light. The magnesium paper prepared in this way is claimed to be durable and entirely free from danger.—Am. Druggist.

Peerless Washing Fluid.

Soap bark, ground.....	8 oz.
Borax.....	4 oz.
Concentrated lye.....	1 lb.
White (ivory) soap (1 bar).....	½ lb.
Oil of turpentine.....	2 oz.
Ammonia water.....	1 pt.
Oil of sassafras.....	½ oz.
Boiling water.....	1 gal.

Shave the soap and dissolve in the boiling water, add the soap bark and borax, stirring them well together frequently for half a day, then strain and add the concentrated lye, oils and ammonia water, shaking them well together. A tablespoonful of this may be used for each gallon of water in which the clothes are put to soak.—The Formulary.

A New Reagent for Bromine and Iodine.—J. H. Kastle has found, in his investigations of halogen derivatives of sulphonamide, that the dichlor derivative of benzol sulphonamide, which is easily obtained by passing chlorine into a solution of benzol sulphonamide in 10 per cent. soda solution, is an excellent reagent for iodine and bromine. By adding it to the solution of an iodide or bromide in the presence of carbon disulphide the salts are decomposed and the iodine or bromine derivative of the amide is formed, which colors carbon disulphide or chloroform just as would iodine or bromine itself. This reaction is quite as delicate as that in which the halogen is detected by chlorine water, and it has the advantage that the reagent remains unchanged on standing.

inception of this city and its growth during two decades is plainly seen at the origin of the curve. In fact, it is generally known that, when it was founded in 1703, compulsory means were employed to increase the population to 100,000 during his reign. Under Elizabeth, from 1741 to 1762, it reached 150,000, and under Catherine II, 1762 to 1796, it reached nearly 300,000. One disturbing feature exists in the census estimates, in that the city has a much larger population in the winter than in the summer, as is well known. The curve of growth includes this winter population and also the immediate suburbs, the object being to arrive at the metropolitan population. In reference to the density of population, the most thickly settled ward has 50,000 inhabitants, or at the rate of 113,636 per square mile, and the most thickly settled district in that ward has a population of 227,276 per square mile. The average for the whole city on an area of 350 square miles is at the rate of 28,260 per square mile.

PEKIN.

The census records of the population of this city are so meager that it has been found impossible to get sufficient data for plotting the curve. The population has decreased regularly since 1797 and is now probably rather less than 1,000,000. Including the immediate suburbs, the area of the city is about twenty-seven square miles.

Recapitulating the statements in regard to ratio of increase at present in the several cities above noted the following summary is given:

Present ratio of increase, London.....	10.4 per cent.
“ “ “ “ Greater London,.....	18.0 “ “
“ “ “ “ New York,.....	33.3 “ “
“ “ “ “ Paris,.....	10.0 “ “
“ “ “ “ last decade,.....	“ “ “
“ “ “ “ Paris, average last three decades,.....	12.7 per cent.
“ “ “ “ Chicago,.....	106.5 “ “
“ “ “ “ Berlin,.....	37.0 “ “
“ “ “ “ Philadelphia,.....	25.0 “ “
“ “ “ “ St. Petersburg,.....	15.0 “ “

methods of transportation may bring about, either taking people more quickly and cheaply into cities, or out of them into more distant districts now open areas or sparsely settled country. Second, the congestion or overcrowding of city areas, making them too dense for comfort or health. These two conditions are already producing changes of magnitude in population. London is an instance of these effects or of some others possibly; several of the central districts, instead of showing an increase, showed actual decrease in the last two census epochs.

It is difficult to predict now what change will take place in New York during the succeeding decades by the contemplated transportation changes; such as the opening of the bridge over the East River at Blackwell's Island, the new East River Bridge at Grand Street, the construction of one of the chartered bridges over the North River and probably the completion of the tunnel, the expenditure of perhaps \$60,000,000 in new rapid transit facilities, the substitution of electric locomotives and trolley lines for the present railroad locomotives, perhaps even the introduction of high speed bicycle trains, etc.

As to Chicago, which is the phenomenal city of the world in respect to rapidity of growth, it may be safely assumed that its ratio of growth will continue with no great diminution for two decades at least to come. Precedent, or the history rather of great cities, goes to show this, and then its remarkably advantageous position commercially gives additional reason for this belief.

Berlin may also be expected to grow with great rapidity for at least two decades more. As the seat of a new empire, it is still young, strong, vigorous and ambitious.

And in addition to all other reasons for the continuance in rapid growth of the above mentioned cities, there must be taken into account that of the modern tendency to gravitate to great centers of population which modern methods of transportation have accelerated.

Even with the above problematic conditions disturbing the future, there is sufficient ground on which to