quarter and one-half that of the fan, according to the kind of fan used. If the ratio of the orifices is one-third, the efficiency in all these fans is not more than 2 to 3 per cent. below the maximum, but it falls rapidly when the ratio is outside the limits ½ and ¼. Hitherto there has been a "good old theory" among colliery workers to have large airways and plenty of them, but this theory Mr. Halbaum compares to remedying the defects of a pump by enlarging its suction pipe. The investigation is largely based on the theories of Mr. Murgue, of St. Etienne, from whom, however, Mr. Halbaum differs in certain particulars. We hope the author will be successful in convincing mine owners that mathematical calculations are of more value than "good old theories," but the slow progress which mathematicians are able to effect in breaking down conservatism in other directions does not make his outlook hopeful.

WE have received the first number of *West India*, a bi-monthly illustrated magazine of thirty pages, published by Messrs. Lightbourn's Sons, price ten cents. Its contents are of a very general character, being "devoted to questions and persons and things generally," in prose and verse. The principal article in the issue before us is one by Mr. Francis Watts, on "Glimpses of the Leeward Islands." The Picture Stone, at Harte's Bay, St. Kitts, is dealt with in verse by Dr. Branch.

UNDER the title of *The Illustrated Scientific News*, a new monthly journal devoted to popular science has made its appearance, and we offer it best wishes for a long and successful career. With the second number, an excellent full-page portrait of Lord Kelvin is presented as a supplement. The journal is concerned with inventions and other aspects of engineering work as well as with purely scientific advances. There are, for instance, articles on the 4·7 gun and the Diesel oil engine, as well as on such scientific studies as sounding the atmosphere with kites, Becquerel rays and Foucault's pendulum. Prof. H. H. Turner lightens the pages with a few anecdotes, and asks for other stories of scientific men and manners. This varied contents should find an interested public.

THE thirty-fourth volume of the *Transactions* and *Proceedings* of the New Zealand Institute, which deals with the year 1901, runs to 627 pages and is illustrated by 42 plates. When it is remembered that the Institute includes eight incorporated societies, the proceedings of each of which are here reported, and that the *Transactions* are concerned with zoology, botany, geology, chemistry, physics and miscellaneous subjects, the impossibility of describing the contents of the volume in a short note will be at once understood. In his presidential address to the Auckland Institute, Mr. J. Stewart considered, amongst others, the subject of technical education. He insisted that a youth cannot be taught a trade at a technical school in a manner to enable him to take his place among those who have served a regular apprenticeship to that trade; but that the use of his hands in mechanical handicraft is one of the easiest things for a young man to acquire. The great aim of technical education, he said, is to prepare the intellect to receive and master the scientific basis of all construction and of all manufactures. A paper, also read before the Auckland Institute, by Mr. Elsdon Best, describes very fully the diversions of the "Whare Tapere," a house where the young people of a village gathered at night in order to amuse themselves in various ways, and gives an account of the games, amusements and trials of skill practised by the Maori in former times. A second contribution by Mr. Best of the same date to the same society contains notes upon witchcraft, magic rites and various superstitions as practised or believed by the old-time Maori. Captain F. W. Hutton, F.R.S., is credited with numerous papers, treating of the beetles of the Auckland Isles and other zoological subjects. Other papers are by Profs. Dendy, Benham, A. P. W. Thomas, J. Park and T. H. Easterfield, and when the fifty-four articles brought together in the volume by the director of the Institute, Sir James Hector, K.C.M.G., F.R.S., are considered, the conclusion is reached that science is being worthily advanced by workers at the antipodes.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. T. Turner; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. E. C. Holland; three Indian Porphyrios (*Porphyrio calvus*) from Java, presented by Mr. A. D. Grange; a Woodcock (*Scolopax rusticula*) European, presented by Mr. W. C. Reid; two Common Chameleons (*Chamoeleon vulgaris*) from North Africa, presented by Mr. E. V. Wash; a Smith's Dwarf Lemur (*Microcebus smithi*) from Madagascar, a Barnard's Parrakeet (*Platycercus barnardi*) from South Australia, deposited; a Stone Curlew (*Œdicnemus scolopax*) European, purchased.

OUR ASTRONOMICAL COLUMN.

COMET 1902 *b* AS OBSERVED IN CEYLON.—Mr. H. O. Barnard, of the Ceylon Survey, has communicated some interesting details of Comet 1902 *b*, as observed by him in Ceylon, to the *Ceylon Observer* of October 11.

He records the comet's appearance, using a telescope of "moderate power," as an egg-shaped mass of nebulosity having a very distinct star-like nucleus which is of a reddish colour, and a tail which extended to about 1°·5 from the nucleus on October 7, giving the whole object a "tadpole" appearance; he further adds that it was easily visible to the naked eye, whilst an opera-glass showed a faint trace of the tail, but no nucleus.

Mr. Barnard's computations show that the comet increased its distance from the earth by 45 million (37 million to 82 million) miles during the period October 8 to 28, inclusive, and that its diameter was 200,000 miles, its volume 600 times that of the earth, whilst the length of the tail, on October 7, was about one million miles.

Mr. Barnard expects the comet to be visible again, in Ceylon, just before sunrise in December.

NEW MINOR PLANETS.—Prof. Max Wolf announces, in Nos. 3821 and 3824 of the *Astronomische Nachrichten*, the discovery of five new minor planets. The dates of discovery, positions and magnitudes of these objects are as follows:—

Planet.	Date.	Heidelberg M.T	α	δ	Mag.
		h. m.	h. m.	° ′	
1902 J.V.	Oct. 7	10 38·8	2 9·7	+10 55	12·5
,, J.W.	,, 7	13 25·8	2 5·2	3 18	13·0
,, J.X.	,, 7	,, ,,	1 52·9	2 55	13·5
,, J.Y.	,, 24	12 10·3	1 55·2	12 14	13·5
,, J.Z.	,, 24	,, ,, 1 59·2		+12 59	13·0

The daily movements of the respective planets are J.V. −om.·7, −2′; J.W., −om.·8, −6′; J.X., −om.·7, −6′; J.Y., −om.·8, −6′; J.Z., om.·7, −8′.

The planet discovered by Prof. Wolf on October 7 and designated 1902 J.U. proved to be the same as (106) Dione.

NEAR APPROACH OF COMET 1902 *b* TO MERCURY.—A telegram from Prof. Pickering, dated Cambridge, Mass., October 29, announces that Prof. Seagrave finds that Comet 1902 *b* will approach to within two million miles of the planet Mercury on November 29.

Herr M. Ebell, Kiel, has confirmed this telegram from the parabolic elements published by Herr Elis Strömgren in No. 3821 of the *Astronomische Nachrichten*, and which were computed from observations made at Lick (September 1), Nicolaiew (September 20·4) and Strasburg (October 8·4). From the ephemeris accompanying these elements it is seen that the declination of the comet will be too southerly for any further observations to be made in England until about the middle of February, and that its brightness at that time (February 11) will be only 2·1 times its brightness at the time of its discovery, whilst by the end of February this ratio will be reduced to 0·6 (*Astronomische Nachrichten*, No. 3821).

THREE STARS WITH LARGE PROPER MOTIONS.—M. A. Verschaffel communicates to No. 3824 of the *Astronomische Nachrichten* the positions of the stars B.D. +24°·2439, 24·2733[1] and 24·2733[2], as recently observed by him at Abbadia, and compares them with the positions given in the catalogue A.G. Berlin B. and brought to 1900 by the corrections for precession and secular variation given in the catalogue, thereby demonstrating the existence of a large amount of proper motion for each star.

THE PYRAMID SPOT ON JUPITER.—Herr Leo Brenner, in writing to *The Observatory* (No. 324), explains the great discrepancies which have appeared between the positions, and velocity, of the "pyramid" spot as determined by himself and as determined by the English observers Messrs. Denning and Phillips.

He found that the centre of the formation travelled, during a year, at the mean velocity of 0°·5 per day, and then Messrs. Denning and Phillips recorded that, according to observations made on June 28, it had moved at a mean velocity of nearly 7°·0 per day for a period of nine days. This great change of velocity seemed impossible, but Herr Brenner has found a solution to the difficulty in the observed fact that it is not *one* spot that is being observed, but a series of three or four spots, and of these, some are new formations of which Messrs. Denning and Phillips had measured the position as though they were portions of the original spot, thus obtaining the great differences in position noted above.

Herr Brenner has arrived at the conclusion that neither the markings seen by him during August and September, nor those seen by the English observers on June 28, can be identical with the "pyramid" spot of last year, and these conclusions are strengthened by the observations of Señor Comas Solá, which were published lately in the *Bulletin de la Société Astronomique de France*.

EPHEMERIS FOR COMET TEMPEL$_3$-SWIFT.—In continuation of the ephemeris given in *Astronomische Nachrichten*, No. 3811, M. J. Bossert now publishes the following ephemeris for this comet.

12h. M.T. Paris.

1902.	R.A. h. m. s.	Decl. ° ′	log r.	log Δ.
Nov. 10	20 3 45	−16 6·2	0·1697	0·1596
,, 15	20 14 42	−15 26·6	0·1591	0·1603
,, 20	20 26 19	−14 42·2	0·1486	0·1606
,, 25	20 38 35	−13 52·6	0·1383	0·1603
,, 30	20 51 29	−12 57·5	0·1282	0·1595
Dec. 5	21 4 57	−11 56·3	0·1184	0·1584
,, 10	21 19 0	−10 49·5	0·1089	0·1566
,, 15	21 33 38	−9 36·7	0·1000	0·1546
,, 20	21 48 51	−8 17·4	0·0917	0·1525
,, 25	22 4 35	−6 52·0	0·0843	0·1502
,, 30	22 20 51	−5 21·0	0·0776	0·1479

Kiel Circular, No. 53.

THE AUTOMATIC TELEPHONE EXCHANGE.

THE object of the automatic telephone exchange is to dispense with the assistance of a third party in making connection between two subscribers. Those who are at all familiar with the complexity of the connections and of the numerous devices needed in a modern exchange having a large number of subscribers will realise that to work out a system in which the telephone girl is replaced by an automatic arrangement is a matter requiring no little ingenuity, and will, perhaps, not be surprised that the problem has apparently only been attacked successfully on the other side of the Atlantic. The American technical papers have shown that, during the past few years, the construction of automatic exchanges has received considerable attention and that several different systems have been worked out. Some attempts have been made to introduce these into this country, but not with much success; in fact, until the last year or so England did not afford a promising field for the introduction of automatic telephones unless for small private exchanges. In America, however, matters are different, and, as we have said, descriptions of two or three different systems in actual or experimental use have been published. One of these, recently described in the *Scientific American*, is noteworthy for the fact that the automatic apparatus at the exchange is operated mechanically so far as possible, the electrical control being reduced to a minimum. Greater trustworthiness, it is said, is obtained by this means, though we should be inclined to think that the wear and tear would also be greater. We do not know whether this, the Faller, system has had any extensive trial as yet. Another system, which we propose to describe briefly, has been in operation in some parts of America for three or four years, and as it is being installed now in several large American towns, and is also being introduced into Germany and England, we may judge that it has proved both trustworthy and economical. In Chicago, an exchange on this system is being constructed with an ultimate capacity of 100,000 subscribers.

This system is known as the "Strowger" system. We have had an opportunity of inspecting a small model installation representing part of an exchange suitable for 10,000 subscribers, and were struck by the ease and simplicity of its working and its great convenience from the subscriber's point of view. Of course, working a small portion of an exchange under exhibition conditions is one thing and running the complete system continuously, with all the subscribers connected, is another; but there was little to lead one to suppose that the working under the more arduous conditions of actual service would be any less satisfactory, and indeed the success which has attended the operation of three or four large exchanges in America is direct evidence to the contrary. One of these, at Fall River, Mass., has been in operation for two years and, with an ultimate capacity of 10,000 subscribers, already has 4000 connected. Apart from the clerical staff, only five people are required to look after this exchange, and these are said to spend most of their time connecting up new subscribers; at night and on Sundays the exchange is left to take care of itself.

We may first of all consider the subscriber's instrument; this takes no more room than, and looks very much like, an ordinary wall set. There is, however, no magneto ringer, and on the front of the box is a circular metal disc having ten holes on the right-hand side numbered from 0 to 9; below this is a ringing-up push. Suppose a subscriber wishes to call up No. 5683; he takes his receiver off the hook in the usual manner and, putting his finger in the hole marked 5, rotates the disc until his finger comes against a stop; he then allows the disc to return to its normal position and repeats the operation with the holes marked 6, 8 and 3 in succession. He is now connected through, and if No. 5683 is engaged, will hear a buzzing in his receiver; if not, he has only to press the ringing-up push and wait until his call is answered. When he puts back his receiver on the hook, all the connections are restored to their original condition. The time taken to get connected through—or to find out that the number you require is engaged—is considerably less than with the ordinary system, even when the exchange girl replies to your call and connects you up immediately, which, as telephone users know, happens but rarely.

The apparatus at the exchange consists of a number of automatic switches known as "first" and "second selectors" and "connecting switches." The construction of all these is very similar, but is too complicated to describe in detail; we can only indicate the principle upon which they work. The switch consists of a semi-cylinder, along the axis of which is the switch-arm. This arm can be raised or lowered in ten steps and also rotated so that its contact can be brought up to any of the contacts on the inside of the semi-cylinder; these are arranged in ten rows of ten contacts each. We may best understand the operation of these switches by following out what happens on ringing up, say, No. 5683. Each subscriber has a "first selector" switch of his own at the exchange, and the first movement of the dial on his instrument operates this switch. As he draws down the hole 5 to the stop, a succession of five current impulses are sent along the line, and these raise the central switch-arm to the fifth row up on his switch. This picks out all the subscribers whose numbers begin with 5000, by connecting the caller to the group of "second selectors" corresponding thereto; there are ten connecting or "trunk" lines leading from the first selectors to the second, and the switch-arm, when it has risen to the fifth row, rotates until it picks out a disengaged trunk, passing over any which are in use by other subscribers. The second movement of the dial operates the second selector in precisely the same way, raising its arm to the sixth row of contacts and causing it to rotate over that row until it picks out a disengaged trunk line leading to the group of subscribers with numbers beginning with 5600. The remaining two movements operate the selector switch and are