to promote exchange between genetic materials of unrelated origin, *E. coli* and other living organisms have succeeded to accomplish a relatively high overall stability in their genetic make-up.

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1 O.T. Avery, C.M. MacLeod and M. McCarty, J. exp. Med. *79,* 137 (1944).
2 A.D. Hershey and M. Chase, J. gen. Physiol. *36,* 39 (1952).
3 J.D. Watson and F.H.C. Crick, Nature *171,* 737 (1953).
4 G. Kellenberger, M.L. Zichichi and J.J. Weigle, Proc. natl Acad. Sci. (USA) *47,* 869 (1961).
5 M. Meselson and J.J. Weigle, Proc. natl Acad. Sci. (USA) *47,* 857 (1961).
6 E.L. Wollman, Annls Inst. Pasteur *84,* 281 (1953).
7 E.M. Lederberg and J. Lederberg, Genetics *38,* 51 (1953).
8 F. Jacob, Virology *1,* 207 (1955).
9 M.L. Morse, E.M. Lederberg and J. Lederberg, Genetics *41,* 142 (1956a).
10 M.L. Morse, E.M. Lederberg and J. Lederberg, Genetics *41,* 758 (1956b).
11 W. Arber, Arch. Sci. (Genève) *11,* 259 (1958).
12 W. Arber, G. Kellenberger and J.J. Weigle, Schweiz. Z. allg. Path. Bakteriol. *20,* 659 (1957).
13 A.M. Campbell, Adv. Genet. *11,* 101 (1962).
14 H.A. Nash, Curr. Topics Microbiol. Immun. *78,* 171 (1977).
15 A. Landy and W. Ross, Science *197,* 1147 (1977).
16 F. Jacob and E.L. Wollman, Annls Inst. Pasteur *91,* 486 (1956).
17 W. Arber, Virology *11,* 273 (1960).
18 S.E. Luria and M.L. Human, J. Bact. *64,* 557 (1952).
19 G. Bertani and J.J. Weigle, J. Bact. *65,* 113 (1953).
20 E.S. Anderson and A. Felix, Nature *170,* 492 (1952).
21 D.J. Ralston and A.P. Krueger, Proc. Soc. exptl Biol. Med. *80,* 217 (1952).
22 S. Lederberg, Virology *3,* 496 (1957).
23 W. Arber and D. Dussoix, J. molec. Biol. *5,* 18 (1962).
24 W. Arber, Path. Microbiol. *25,* 668 (1962).
25 A.D. Hershey, M.D. Kamen, J.W. Kennedy and H. Gest, J. Gen. Physiol. *34,* 305 (1951).
26 G.S. Stent and C.R. Fuerst, J. gen. Physiol. *38,* 441 (1955).
27 D. Dussoix and W. Arber, J. molec. Biol. *5,* 37 (1962).
28 W. Arber, J. molec. Biol. *11,* 247 (1965).
29 J.D. Smith, W. Arber and U. Kühnlein, J. molec. Biol. *63,* 1 (1972).
30 U. Kühnlein and W. Arber, J. molec. Biol. *63,* 9 (1972).
31 K. Horiuchi and N.D. Zinder, Proc. natl Acad. Sci. (USA) *69,* 3220 (1972).
32 W. Arber, R. Yuan and T.A. Bickle, Proc. 9th FEBS Meeting Budapest 1974. Post-Synthetic Modification of Macromolecules, vol. 34, p. 3. Ed. F. Antoni and A. Farago. Budapest 1975.
33 R. Yuan, T.A. Bickle, W. Ebbers and C. Brack, Nature *256,* 556 (1975).
34 T.A. Bickle, C. Brack and R. Yuan, Proc. natl Acad. Sci. (USA) *75,* 3099 (1978).
35 S. Chang and S.N. Cohen, Proc. natl Acad. Sci. (USA) *74,* 4811 (1977).
36 P. Starlinger and H. Saedler, Curr. Topics Microbiol. Immun. *75,* 111 (1976).
37 A.I. Bukhari, J.A. Shapiro and S.L. Adhya, DNA Insertion Elements, Plasmids, and Episomes. 1977 by Cold Spring Harbor Laboratory, USA.
38 W. Arber, S. Iida, H. Jütte, P. Caspers, J. Meyer and Ch. Hänni, Cold Spring Harbor Symp. quant. Biol. *43,* (in press) (1979).

SPECIALIA

Lane-Emden equation (LEE) of index 5 and Padé approximations

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Summary. The approximate analytical solution of Lane-Emden equation of index 5 has been found in the form of the rational function. The problem of the accuracy of this solution is briefly discussed.

It is well known that LEE, which is widely used in many astrophysical applications, has analytical solutions (E-type) only for values of index equal to 0, 1 and 5[3]. For other values, one has to proceed with numerical calculations. But sometimes only the values of function for some prescribed separate values of argument are needed. In such cases, it is not quite reasonable to use computers, programmes, Runge-Kutta methods, and so on. Therefore it will be of great importance to have ready in hand some simple approximate analytical solutions of LEE. In this note we present such F- and M-solutions of LEE for index 5.

$$\frac{dz}{dt} = \pm \left(2D + \frac{z^2}{4} - \frac{z^6}{12}\right)^{1/2}. \tag{1}$$

We start with the series solution[4,5]:

$$z_s(t) = \sum_{n=0}^{\infty} a_n t^n, \tag{2}$$

and present the function z (t) as Padé (2,2) approximant:

$$z_{22}(t) = \frac{A + Bt + Ct^2}{A + Et + Ft^2}. \tag{3}$$

Table 1

$-t$	z_{num}	z_{22}	z_{ser}
0.00	1.0000	1.00000	1.0000
	1.0000	1.00000	1.0000
0.25	0.8920	0.89297	0.8931
	0.9042	0.90514	0.9052
0.50	0.7892	0.79083	0.7941
	0.8133	0.81474	0.8174
0.75	0.6938	0.69623	0.7155
	0.7293	0.73130	0.7469
1.00	0.607	0.61014	0.679
	0.653	0.65582	0.711
1.25	0.528	0.53260	0.719
	0.586	0.58835	0.739
1.50	0.457	0.46314	0.890
	0.527	0.52846	0.873
1.75	0.393	0.40107	1.268
	0.475	0.47548	1.173
2.00	0.335	0.34562	1.956
	0.431	0.42865	1.722

Table 2

D	$-t$	D	$-t$	D	$-t$
0.01	4.7681	0.04	3.1343	0.07	2.4914
0.02	3.8605	0.05	2.8672	0.08	2.3512
0.03	3.4718	0.06	2.6598	0.09	2.2320
				1.00	2.1292

By usual procedure[6] we find from (3) and (2), the following expressions for the coefficients in (3):

$$\left.\begin{aligned} &A = 12,\ B = 3\psi,\ C = 2 - 15\psi^2 \\ &E = 15\psi,\ F = 2; \\ &\psi = \left(2D + \frac{1}{6}\right)^{1/2}. \end{aligned}\right\} \tag{4}$$

We have calculated the function z(t) by the methods of our approximate analytical (3, 4), numerical, and series (2) solutions. Some results for 2 values of *D*, +0.01 (F-solution, upper entries in z's) and −0.01 (M-solution, lower entries in z's) are presented in table 1.

It is evident that our approximation is far more exact than series solution and is quite close to numerical solution, and this is true for any value of D.

To show further the usefulness of present approach we have calculated, from quadratic equation $A + Bt + Ct^2 = 0$, the boundary values of t, for which $z = 0$ (table 2).

It is, of course, much more difficult to obtain these boundary values by numerical calculations from original differential equation (1)!

The more detailed results for other values of D and the next Padé approximations will be presented elsewhere.

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3 S. Chandrasekhar, An Introduction to the Study of Stellar Structure, Chapt. 4. University of Chicago Press, 1939.
4 J.P. Sharma and Shambhunath Srivastava, Experientia *24*, 764 (1968).
5 J.P. Sharma, Thesis, University of Allahabad, Allahabad, India 1970.
6 G. Baker, in: Essentials of Padé Approximations. Academic Press, New York 1974.

A crystalline, toxic, peptide metabolite of *Trichoderma* spp. isolated from soil

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Summary. Isolates of *Trichoderma* spp. from pasture soils of Nova Scotia produce at least 7 toxic peptides, probably related to alamethicin, some of which inhibit the growth of cellulase producing rumen bacteria. One of the peptides has been obtained in crystalline form and crystal data on this material is reported.

Isolates of the genus *Trichoderma* producing toxic peptides account for about 2% of the fungal propagules grown in the laboratory from soil samples taken from permanent pastures at Nappan, Nova Scotia[1]. The crude peptide metabolites affected rumen fermentation, and in particular, cellulose digestion. These metabolites are therefore implicated in the ill-thrift of pasture fed ruminants in Nova Scotia[2]. The production of toxic peptides by *Trichoderma* spp. [3-5] has been reported and these peptides receive some attention because they affect the physiological function of membranes[6,7]. At least 3 structures for these peptides have been proposed[8-10] and all have been claimed to be synthesized[11,12,18]. Unfortunately, the physical, chemical and biological properties of the synthetic materials differed from the natural products.

Trichoderma isolates from soil samples collected from permanent pastures at Nappan, Nova Scotia were grown for 7 days at 25°C on a rotatory shaker. The cultures were